

Project Manual Volume 1

Raytown Quality Schools

Herndon Restaurant

11501 East 350 Highway
Raytown, Missouri 64133

Prepared For:
Raytown Quality Schools
6608 Raytown Road
Raytown, MO 64113

Project Number: 17048
Issue Date: March 8, 2019

Contents:

Volume 1: Introductory Information, Bidding and Contracting Requirements,
Division 1 through Division 13.

Volume 2: Divisions 21 through 33 Specifications.



we design the future®

HOLLISANDMILLER.COM

1828 Walnut Street Suite 922 | Kansas City, MO 64108 | 816.442.7700
Missouri | Kansas | Colorado



DOCUMENT 000101 – PROJECT TEAM DIRECTORY

PROJECT: Herndon Restaurant
11501 E. 350 Highway
Raytown, Missouri 64133

OWNER: Raytown Quality Schools
6608 Raytown Road
Raytown, Missouri 64113

ARCHITECT: Hollis + Miller Architects, Inc.
1828 Walnut Street, Suite 922
Kansas City, Missouri 64108-1867
Contact: Sandy Cochran
Phone: 816.442.7700

STRUCTURAL ENGINEER: Hollis + Miller Architects, Inc.
1828 Walnut Street, Suite 922
Kansas City, Missouri 64108-1867
Contact: John Funk
Phone: 816.442.7700

MEP ENGINEER: Smith & Boucher, Inc.
25501 West Valley Parkway, Suite 200
Olathe, Kansas 66061
Contact: Kent McCosh
Phone: 913.345.2127

CIVIL ENGINEER: MKEC Engineering, Inc.
118127 W. 112nd Street, Suite 200
Overland Park, Kansas 66210
Contact: Brian Hill
Phone: 913.317.9390

FOOD SERVICE CONSULTANT: Santee Becker & Associates
6700 Squibb Road, Suite 101
Mission, Kansas 66202
Contact: John Kennedy
Phone: 913.362.1800

END OF DOCUMENT 000101

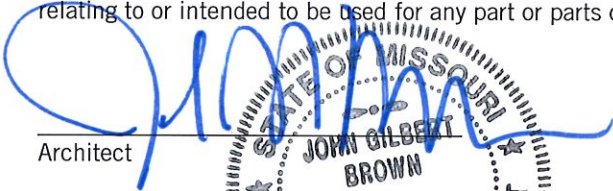
DOCUMENT 000105 – CERTIFICATIONS AND SEALS

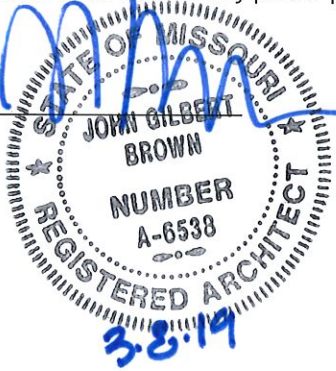
Architect:

I hereby state, pursuant to RSMo 327.411, that the Specifications intended to be authenticated by my seal are limited to Specification Sections listed below:

- Division 1 Sections
- Division 2 Sections
- Division 3 Section: 035416
- Division 5 Sections: 055000, 055100
- Division 6 Sections
- Division 7 Sections
- Division 8 Sections
- Division 9 Sections
- Division 10 Sections
- Division 11 Section: 116673
- Division 12 Sections
- Division 14 Section
- Division 31 Sections: 313116, 313200.

I hereby disclaim any responsibility for all other specifications, drawings estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project or survey.


Architect



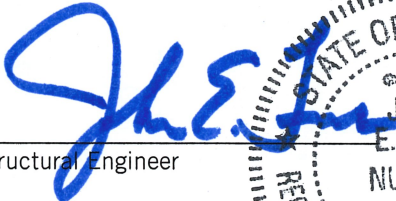
March 8, 2019
Date

Structural Engineer:


I hereby state, that the Specifications intended to be authenticated by my seal are limited to Specification Sections listed below:

Division 3 Section: 033000.
Division 4 Section: 042000.
Division 5 Section: 055213

I hereby disclaim any responsibility for all other specifications, drawings estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project or survey.



Structural Engineer



Date

March 8, 2019

3/8/19

DOCUMENT 000105 - CERTIFICATIONS AND SEALS-MEP

Mechanical/Electrical/Plumbing Engineer

I hereby state, pursuant to RSMo 327.411, that the Specifications intended to be authenticated by my seal are limited to Specification Sections listed below:

- Division 21 Sections: 210500, 211100, 211313;
- Division 22 Sections: 220500, 220513, 220516, 220519, 220523, 220529, 220553, 220719, 221116, 221119, 221316, 221319, 221323, 224000, 224700;
- Division 23 Sections: 230500, 230529, 230553, 230593, 230713, 230719, 230900, 231123, 232113, 232300, 233113, 233300, 233416, 233713, 233813, 237413, 237423.13;
- Division 26 Sections: 260500, 260519, 260526, 260529, 260533, 260544, 260553, 260923, 260943, 262413, 262416, 262726, 262813, 262816, 265119, 265219, 265119;
- Division 27 Sections: 270500, 270526, 270528, 271100;
- Division 28 Sections: 283111.

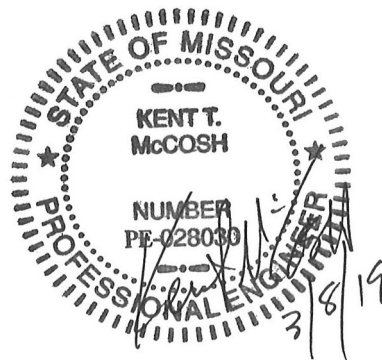
I hereby disclaim any responsibility for all other specifications, drawings estimates, reports or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project or survey.



Kent T. McCosh, P.E., LEED® AP

3/8/19

Date



DOCUMENT 0001100 – TABLE OF CONTENTS

Raytown Quality Schools – Herndon Restaurant
 11507 East State Route 350
 Raytown, Missouri

Project No. 17048

	CURRENT ISSUE <u>DATE</u>	ORIGINAL ISSUE <u>DATE</u>	
INTRODUCTORY INFORMATION			
000101	Project Team Directory	03.08.19	03.08.19
000105	Certifications and Seals	03.08.19	03.08.19
000110	Table of Contents	03.08.19	03.08.19
BIDDING REQUIREMENTS			
001100	Invitation to Bid	03.08.19	03.08.19
002100	Instructions to Bidders	03.08.19	03.08.19
002200	Supplementary Instructions to Bidders	03.08.19	03.08.19
003132	Geotechnical Data	03.08.19	03.08.19
004200	Proposal Form	03.08.19	03.08.19
004313	Bid Security Form	03.08.19	03.08.19
004513	Bidder’s Qualifications	03.08.19	03.08.19
CONTRACTING REQUIREMENTS			
005200	Agreement Form	03.08.19	03.08.19
006113	Performance and Payment Bond	03.08.19	03.08.19
006273	Application and Certification for Payment	03.08.19	03.08.19
006275	Partial Lien Waiver	03.08.19	03.08.19
006276	Bailment Receipt	03.08.19	03.08.19
006277	Bill of Sale	03.08.19	03.08.19
007200	General Conditions	03.08.19	03.08.19
007300	Supplementary Conditions	03.08.19	03.08.19
008100	Prevailing Wage Determination	03.08.19	03.08.19
008400	Attachments	03.08.19	03.08.19
DIVISION 1 – GENERAL REQUIREMENTS			
001100	Summary	03.08.19	03.08.19
012100	Allowances	03.08.19	03.08.19
012200	Unit Prices	03.08.19	03.08.19
012300	Alternates	03.08.19	03.08.19
012500	Substitution Procedures	03.08.19	03.08.19
012600	Contract Modification Procedures	03.08.19	03.08.19
012900	Payment Procedures	03.08.19	03.08.19
013100	Project Management and Coordination	03.08.19	03.08.19
013200	Construction Progress Documentation	03.08.19	03.08.19
013300	Submittal Procedures	03.08.19	03.08.19
014000	Quality Requirements	03.08.19	03.08.19
014200	References	03.08.19	03.08.19
014529	Testing and Laboratory Services	03.08.19	03.08.19
015000	Temporary Facilities and Controls	03.08.19	03.08.19
016000	Product Requirements	03.08.19	03.08.19
DIVISION 1 – GENERAL REQUIREMENTS - continued			
017300	Execution	03.08.19	03.08.19
017419	Construction Waste Management & Disposal	03.08.19	03.08.19

		CURRENT ISSUE DATE	ORIGINAL ISSUE DATE
017700	Closeout Procedures	03.08.19	03.08.19
017823	Operation and Maintenance Data	03.08.19	03.08.19
017839	Project Record Documents	03.08.19	03.08.19
017900	Demonstration and Training	03.08.19	03.08.19
DIVISION 2 – EXISTING CONDITIONS			
024116	Structure Demolition	03.08.19	03.08.19
DIVISION 3 – CONCRETE			
033000	Cast-in-Place Concrete	03.08.19	03.08.19
033523	Decorative Polished Concrete Finishes	03.08.19	03.08.19
DIVISION 4 – MASONRY – Not Used			
DIVISION 5 - METALS			
054000	Cold-Formed Metal Framing	03.08.19	03.08.19
055000	Metal Fabrications	03.08.19	03.08.19
057500	Decorative Formed Metal	By Addendum #1	
DIVISION 6 – WOOD AND PLASTICS			
061000	Rough Carpentry	03.08.19	03.08.19
061063	Exterior Rough Carpentry	03.08.19	03.08.19
061600	Sheathing	03.08.19	03.08.19
064023	Interior Architectural Woodwork	03.08.19	03.08.19
066400	Plastic Paneling	03.08.19	03.08.19
DIVISION 7 - THERMAL AND MOISTURE PROTECTION			
071113	Bituminous Dampproofing	03.08.19	03.08.19
072100	Thermal Insulation	03.08.19	03.08.19
072500	Weather Barriers	03.08.19	03.08.19
074213	Formed Metal Wall Panels	03.08.19	03.08.19
076200	Sheet Metal Flashing and Trim	03.08.19	03.08.19
077200	Roof Accessories	03.08.19	03.08.19
078413	Penetration Firestopping	03.08.19	03.08.19
078446	Fire-Resistive Joint Systems	03.08.19	03.08.19
079200	Joint Sealants	03.08.19	03.08.19
DIVISION 8 - DOORS AND WINDOWS			
081113	Hollow Metal Doors and Frames	03.08.19	03.08.19
081416	Flush Wood Doors	03.08.19	03.08.19
083113	Access Doors and Panels	03.08.19	03.08.19
084113	Aluminum Entrances and Storefronts	03.08.19	03.08.19
087100	Door Hardware	03.08.19	03.08.19
088000	Glazing	03.08.19	03.08.19
DIVISION 9 - FINISHES			
092116	Non-Structural Metal Framing	03.08.19	03.08.19
092900	Gypsum Board	03.08.19	03.08.19
093000	Tiling	03.08.19	03.08.19
095113	Acoustical Panel Ceilings	03.08.19	03.08.19
095433	Decorative Suspended Ceilings	03.08.19	03.08.19
096513	Resilient Base and Accessories	03.08.19	03.08.19

		CURRENT ISSUE DATE	ORIGINAL ISSUE DATE
096519	Resilient Tile Flooring	03.08.19	03.08.19
096723	Resinous Flooring	03.08.19	03.08.19
098436	Sound-Absorbing Ceiling Units	03.08.19	03.08.19
099113	Exterior Painting	03.08.19	03.08.19
099123	Interior Painting	03.08.19	03.08.19
099300	Staining and Transparent Finishing	03.08.19	03.08.19
099600	High-Performance Coatings	03.08.19	03.08.19
DIVISION 10 – SPECIALTIES			
101400	Signage	03.08.19	03.08.19
101423	ADA and Code Signage	03.08.19	03.08.19
102113	Toilet Compartments	03.08.19	03.08.19
102800	Toilet, Bath & Laundry Accessories	03.08.19	03.08.19
103100	Manufactured Fireplaces	03.08.19	03.08.19
104413	Fire Extinguisher Cabinets	03.08.19	03.08.19
104416	Fire Extinguishers	03.08.19	03.08.19
105113	Metal Lockers	03.08.19	03.08.19
DIVISION 11 – EQUIPMENT - Not Used			
DIVISION 12 - FURNISHINGS			
122413	Roller Window Shades	03.08.19	03.08.19
123200	Manufactured Wood Casework	03.08.19	03.08.19
124813	Entrance Floor Mats and Frames	03.08.19	03.08.19
DIVISION 13 - SPECIAL CONSTRUCTION			
133419	Metal Building Systems	03.08.19	03.08.19
DIVISION 21 – FIRE SUPPRESSION			
210500	Common Work Results for Fire Suppression	03.08.19	03.08.19
211100	Facility Fire-Suppression Water-Service Piping	03.08.19	03.08.19
211313	Wet-Pipe Sprinkler System	03.08.19	03.08.19
DIVISION 22 - PLUMBING			
220500	Common Work Results for Plumbing	03.08.19	03.08.19
220513	Common Motor Requirements for Plumbing Equipment	03.08.19	03.08.19
220516	Expansion Fittings and Loops for Plumbing Piping	03.08.19	03.08.19
220519	Meters and Gauges for Plumbing Piping	03.08.19	03.08.19
220523	General Duty Valves for Plumbing Piping	03.08.19	03.08.19
220529	Hangers and Supports for Plumbing Piping and Equipment	03.08.19	03.08.19
220553	Identification for Plumbing Piping and Equipment	03.08.19	03.08.19
220719	Plumbing Piping Identification	03.08.19	03.08.19
221116	Domestic Water Piping	03.08.19	03.08.19
221119	Domestic Water Piping Specialties	03.08.19	03.08.19
221316	Sanitary Waste and Vent Piping	03.08.19	03.08.19
221319	Sanitary Waste Piping Specialties	03.08.19	03.08.19
221323	Sanitary Waste Interceptors	03.08.19	03.08.19
224000	Plumbing Fixtures	03.08.19	03.08.19
224700	Drinking Fountains/Water Coolers	03.08.19	03.08.19
DIVISION 23 - HEATING, VENTILATING AND AIR CONDITIONING			
230500	Common Work Results for HVAC	03.08.19	03.08.19
230529	Hangers and Supports – HVAC	03.08.19	03.08.19

		CURRENT ISSUE <u>DATE</u>	ORIGINAL ISSUE <u>DATE</u>
230553	HVAC System Identification	03.08.19	03.08.19
230593	Testing, Adjusting, and Balancing	03.08.19	03.08.19
230529	Hangers and Supports – HVAC	03.08.19	03.08.19
230553	HVAC System Identification	03.08.19	03.08.19
230593	Testing, Adjusting, and Balancing	03.08.19	03.08.19
230713	Duct Insulation	03.08.19	03.08.19
230719	HVAC Piping Insulation	03.08.19	03.08.19
230900	Instrumentation and Control for HVAC	03.08.19	03.08.19
231123	Facility Natural-Gas Piping	03.08.19	03.08.19
232113	Hydronic Piping	03.08.19	03.08.19
232300	Refrigerant Piping	03.08.19	03.08.19
233113	Metal Ducts	03.08.19	03.08.19
233300	Duct Accessories	03.08.19	03.08.19
233416	Centrifugal HVAC Fans	03.08.19	03.08.19
233713	Diffusers, Registers, and Grilles	03.08.19	03.08.19
237413	Packaged, Outdoor, Central-Station Air-Handling Units	03.08.19	03.08.19
237423.13	Packaged, Outdoor, Heating-Only Makeup-Air Units	03.08.19	03.08.19

DIVISION 26 - ELECTRICAL

260500	Common Work Results for Electrical	03.08.19	03.08.19
260519	Low-Voltage Electrical Power Conductors and Cables	03.08.19	03.08.19
260526	Grounding and Bonding for Electrical Systems	03.08.19	03.08.19
260529	Hangers and Supports for Electrical Systems	03.08.19	03.08.19
260533	Raceway and Boxes for Electrical Systems	03.08.19	03.08.19
260544	Sleeves and Sleeve Seals for Electrical Raceways And Cabling	03.08.19	03.08.19
260553	Identification for Electrical Systems	03.08.19	03.08.19
260923	Lighting Control Devices	03.08.19	03.08.19
260943	Relay-Based Lighting Controls	03.08.19	03.08.19
262413	Switchboards	03.08.19	03.08.19
262416	Panelboards	03.08.19	03.08.19
262726	Wiring Devices	03.08.19	03.08.19
262813	Fuses	03.08.19	03.08.19
262816	Enclosed Switches and Circuit Breakers	03.08.19	03.08.19
265119	LED Interior Lighting	03.08.19	03.08.19
265219	Emergency and Exit Lighting	03.08.19	03.08.19
265219	LED Exterior Lighting	03.08.19	03.08.19

DIVISION 27 – COMMUNICATIONS

270500	Common Work Results for Communications	03.08.19	03.08.19
270526	Grounding and Bonding for Communications Systems	03.08.19	03.08.19
270528	Pathways for Communications System	03.08.19	03.08.19
271100	Communications Equipment Room Fittings	03.08.19	03.08.19

DIVISION 28 - ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION

283111	Digital, Addressable Fire-Alarm System	03.08.19	03.08.19
--------	----------------------------------------	----------	----------

DIVISION 31 - EARTHWORK

311000	Site Clearing	03.08.19	03.08.19
312000	Earth Moving	03.08.19	03.08.19
313116	Termite Control	03.08.19	03.08.19
313200	Soil Stabilization	03.08.19	03.08.19

DIVISION 32 - EXTERIOR IMPROVEMENTS

		CURRENT ISSUE <u>DATE</u>	ORIGINAL ISSUE <u>DATE</u>
321216	Asphalt Paving	03.08.19	03.08.19
321313	Concrete Paving	03.08.19	03.08.19
321373	Concrete Paving Joint Sealants	03.08.19	03.08.19
DIVISION 33 - UTILITIES			
331100	Water Utility Distribution Piping	03.08.19	03.08.19
333100	Sanitary Utility Sewerage Piping	03.08.19	03.08.19
334100	Storm Utility Drainage Piping	03.08.19	03.08.19

END OF TABLE OF CONTENTS

DOCUMENT 001100 - INVITATION TO BID

1.1 PROJECT INFORMATION

- A. Notice to Bidders: Qualified bidders are hereby invited to submit bids for the Raytown Quality Schools Baseball Stadium Improvements. Bids shall be fully executed, signed and sealed in envelopes as described in this Document according to the Instructions to Bidders and as amended by the Supplementary Instructions to Bidders.
- B. Project Identification: **RAYTOWN HERNDON RESTAURANT**
 - 1. Project Location: 11501 East 350 Highway, Raytown, Missouri 64133.
- C. Owner: Raytown Quality Schools, 6608 Raytown Road, Raytown, MO. 64113.
 - 1. Owner's Representatives: Travis Hux and James Morrill.
- D. Architect: Hollis + Miller Architects, Inc., 1828 Walnut Street, Kansas City, MO. 64108.
 - 1. Architect's Representative: Sandy Cochran. Telephone 816/442-7700.
- E. Project Description: Work of Project is defined by the Contract Documents and consists of the following:
 - 1. General: Architectural, mechanical, electrical and plumbing work as set forth in the Contract Documents.
- F. Construction Contract: Bids will be received for the following Work:
 - 1. General Contract (all trades).
- G. Bidders are advised that the School District is tax exempt pursuant to Sections 144.030.2 and 144.615, RSMo. The School District will furnish the successful Bidder with current copies of their Missouri Project Exemption certificate and Missouri Tax Exemption Letter.
- H. Bidders are further advised that a Prevailing Wage Determination prepared by the Missouri Division of Labor Standards is in effect on this project and is included in this Project Manual. Provisions of Section 290.262 CUM, Supp RSMo (1993) shall apply to this Project. The Annual Wage Order No. 24, Section 048, as filed with the Secretary of State, is attached hereto and made part of this Specification.

1.2 BID SUBMITTAL AND OPENING

- A. Owner will receive sealed bids until the bid time and date at the location indicated below. **Bidders are requested to turn in their bids prior to 2:00 p.m. at the front desk so they may be logged in.** Owner will consider bids prepared in compliance with the Instructions to Bidders issued by Owner, and delivered as follows:
 - 1. Bid Date: **April 2, 2019.**
 - 2. Bid Time: 2:00 p.m., local time.
 - 3. Location: Raytown Administration Building – 6608 Raytown Road, Raytown, Missouri 64133.
- B. Bids will be thereafter publicly opened and read aloud. Bids received after the bid time listed above will be returned to the Bidder unopened.
- C. Bidders electing to mail in their Bids shall address Bids to the Owner, at the address listed above. The envelope shall be clearly marked as noted above. Owner will not be responsible for Bids not clearly marked.
- D. The bidding procedure shall be in accordance with all applicable provision of Missouri law, including but not limited to Mo. Rev, Statue. 177.086.
- E. Bids shall not contain any recapitulation of the work to be done. No oral, telegraphic or telephonic proposals for modifications will be considered.

1.3 BID SECURITY

- A. Bid security shall be submitted with each bid of \$5,000.00 or greater in the amount of 5 percent of the bid amount, including all additive alternates and made payable to the Owner: "Raytown Quality Schools". No bids may be withdrawn for a period of 60 days after opening of bids.
 - 1. Owner reserves the right to reject any and all bids and to waive informalities and irregularities.
 - 2. One single bid security may be obtained for bidding purposes.

- B. All Bid Securities will be retained in escrow by the Architect until an Agreement is signed and a satisfactory Performance and Payment Bond is received by the Owner.

1.4 PREBID CONFERENCE

- A. A prebid conference for all bidders will be held at **Raytown Administration Building – Board Room, 6608 Raytown Road, Raytown, Missouri 64133 on March 25, 2019 at 3:00 p.m.**, local time. Prospective bidders are requested to attend.
 - 1. Touring of the job sites to determine the extent of demolition and conditions under which Work will be conducted at each school will be critical to all Bidders (General Contractors and Subcontractors). Coordinate site tours through James Morrill, Director of Facility Operations, at 5911 Blue Ridge Blvd., Raytown, MO 64133, phone 816-268-7160, email james.morrill@raytownschools.org. As school is currently in session, Bidders are strongly encouraged to schedule tours outside of school hours. As times vary per school, contact James for additional information. Bidders are advised that if tour must be scheduled during school hours, Bidder visit will be limited to those spaces not in use at the time of tour.

1.5 DOCUMENT PROCUREMENT

- A. Printed Procurement and Contracting Documents: Obtain after 3:00p.m. on **March 12, 2019** by contacting the KC Blueprint Company and Planroom, 2106 Swift Street, North Kansas City, Missouri 64116, telephone 816-527-0900. Only complete sets of documents will be issued.
 - 1. Cost: Contact KC Blueprint Company.
 - 2. Shipping: Additional shipping charges of will apply. Contact reprographic house for amount.
- B. Online Procurement and Contracting Documents: Obtain access after 3:00 p.m. on **March 12, 2019** by contacting KC Blueprint Company and Planroom. Online access will be provided to all registered bidders and suppliers.
- C. Plans and specifications will also be available at the following locations for review only at no cost to the Contractor:
 - 1. Hollis + Miller Architects, Inc.
1828 Walnut Street, Suite 922
Kansas City, Missouri 64108
Phone: (816) 442-7700
 - 2. Builders Association
632 West 39th Street
Kansas City, Missouri 64111-2991
 - 3. Dodge/Scan
1702 Broadway
Kansas City, Missouri 64108
Phone: (816) 221-1056
 - 4. Minority Contractors Association
3200 Wayne
Kansas City, Missouri 64108
Phone: (816) 924-4441
- D. A current list of Contractors holding plans will be made available through KC Blueprint Company and Planroom.

1.6 TIME OF COMPLETION, LIQUIDATED DAMAGES

- A. Work may commence after school is back in session for the fall, approximately **September 3, 2019**. Substantial Completion must be achieved on or before **June 30, 2020**. The work will not be deemed to be Substantially Complete until the Work is complete and fully functional for its intended purpose.
- B. Work will not be deemed to be Substantially Complete until the Work is complete and fully functional for its intended purpose.
 - 1. Bidders are advised that the Agreement will contain a stipulated date of Substantial Completion, an incentive bonus for early completion of the project and provision for the assessment of liquidated damages for each day the Work is not complete beyond the designated date of Substantial Completion.
 - 2. Bidders be advised that the Agreement will contain a stipulated date of Substantial Completion, an incentive bonus for early completion of the project and the provision for the assessment of liquidated damages for each day the Work is not complete beyond the designated date of Substantial Completion. \$1000/day for up to 10 days; Maximum of 10 days.

- C. Final Completion: Final completion: It is required by the Owner that Final Completion of the project shall be completed by **July 10, 2020**.

1.7 BIDDER'S QUALIFICATIONS

- A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work. A Performance Bond, a separate Labor and Material Payment Bond, and Insurance in a form acceptable to Owner will be required of the successful Bidder.
- B. Each Contractor desiring to Bid this work must have a minimum of seven (7) years continuous experience under the current company name and must submit the "Contractor's Qualification Statement", AIA Document A305 along with Bid. This Qualification Statement is available at the Office of the American Institute of Architects (AIA) at 1801 McGee Street, Kansas City, Missouri 64108, telephone: (816) 221-3485. The Architect will review the Qualification Statement with the Owner. The Owner has the right to take such steps as he deems necessary, to determine the ability of the Contractor to perform the work. The Contractor shall furnish to the Owner such additional information and data for this purpose as he may request. The right is reserved to reject any Bid, or Bidder, after an investigation or consideration of the information submitted by such Contractor. Refer to Document 004513.
- C. Owner reserves the right to reject any Contractor and Contractor's Proposal where investigation or consideration of the information submitted by the Contractors does not satisfy the Owner that the Bidder has previous experience in performing similar or comparable work, sufficient business and technical organization, financial resources and plant available to perform the Work.

1.8 SUPPLEMENTAL REQUIREMENTS

- A. The selected Bidder shall, within fifteen (15) days after Award of the Contract, submit the following Post-Bid information:
 - 1. A statement of costs of the major portions of the work included in the Bid and any specific item of cost requested.
 - 2. A designation of the Work to be performed by the Bidder with his own forces.
- B. The selected Bidder shall, submit the following with the Bid:
 - 1. A list of names of the Subcontractors, manufacturers, fabricators, and material suppliers or other persons or organizations proposed for each principal portion of the Work as may be designed by the Architect. The Bidder will be required to establish to the satisfaction of the Owner and Architect the reliability and responsibility of the proposed persons or entities to furnish and perform their Work. Prior to the contract, if the Owner or Architect has a reasonable and substantial objection to any person or entity on such list, and refused in writing to accept such person or entity, the bidder may, at his option, withdraw his Bid without forfeiture of Bid Security. If the Bidder submits an acceptable substitute with any increase in his Bid price to cover the difference in cost occasioned by such substitution, the Owner may, at his discretion, accept the increased Bid price or he may disqualify the Bidder. Subcontractors and other persons and entities proposed by the bidders and accepted by the Owner and Architect must be used on the work for which they were proposed and accepted and shall not be changed except with the written approval of the Owner and the Architect.

END OF DOCUMENT 001100

DOCUMENT 002100 – INSTRUCTIONS TO BIDDERS

- A. A copy of the American Institute of Architects Document A701, Instructions to Bidders 1997 Edition, is bound hereinafter as amended by Document 002200 – Supplementary Instruction to Bidders. This Document is included for information only and may not be duplicated.
- B. Additional copies of the Instructions to Bidders may be obtained, at cost, from the Local Chapter, of the American Institute of Architects, at the address listed below:

AIA Kansas City
1801 McGee, Suite 100
Kansas City, Missouri 64108
Telephone: (816) 221-3485.
www.aiakc.org

- C. Additional copies of the Instructions to Bidders may also be obtained, at cost, from the website of the American Institute of Architects, at the internet address listed below:
 - 1. Website: <http://www.aia.org/contractdocs/index.htm>

END OF DOCUMENT 002100

DRAFT AIA® Document A701™ – 2018

Instructions to Bidders

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

< >
< >
< >

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

<< >>
< >
< >
< >

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

<< >> >
< >
< >
< >

TABLE OF ARTICLES

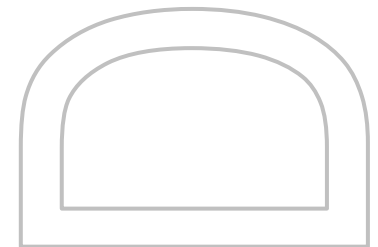
- 1 DEFINITIONS
- 2 BIDDER'S REPRESENTATIONS
- 3 BIDDING DOCUMENTS
- 4 BIDDING PROCEDURES
- 5 CONSIDERATION OF BIDS
- 6 POST-BID INFORMATION
- 7 PERFORMANCE BOND AND PAYMENT BOND
- 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

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

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

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

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



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

ARTICLE 1 DEFINITIONS

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

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

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

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

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

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

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

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

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

ARTICLE 2 BIDDER'S REPRESENTATIONS

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

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

ARTICLE 3 BIDDING DOCUMENTS

§ 3.1 Distribution

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

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

<< >>

§ 3.1.2 Any required deposit shall be refunded to Bidders who submit a bona fide Bid and return the paper Bidding Documents in good condition within ten days after receipt of Bids. The cost to replace missing or damaged paper

documents will be deducted from the deposit. A Bidder receiving a Contract award may retain the paper Bidding Documents, and the Bidder's deposit will be refunded.

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

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

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

§ 3.2 Modification or Interpretation of Bidding Documents

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

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

<< >>

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

§ 3.3 Substitutions

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

§ 3.3.2 Substitution Process

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

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

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

§ 3.3.3 The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.

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

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

§ 3.4 Addenda

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

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

<< >>

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

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

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

ARTICLE 4 BIDDING PROCEDURES

§ 4.1 Preparation of Bids

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

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

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

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

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

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

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

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

§ 4.2 Bid Security

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

(Insert the form and amount of bid security.)

<< >>

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

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

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

§ 4.3 Submission of Bids

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

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

« »

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

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

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

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

§ 4.4 Modification or Withdrawal of Bid

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

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

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

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

« »

ARTICLE 5 CONSIDERATION OF BIDS

§ 5.1 Opening of Bids

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

§ 5.2 Rejection of Bids

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

§ 5.3 Acceptance of Bid (Award)

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

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

ARTICLE 6 POST-BID INFORMATION

§ 6.1 Contractor's Qualification Statement

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

§ 6.2 Owner's Financial Capability

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

§ 6.3 Submittals

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

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

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

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

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

ARTICLE 7 PERFORMANCE BOND AND PAYMENT BOND

§ 7.1 Bond Requirements

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

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

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

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

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

<< >>

§ 7.2 Time of Delivery and Form of Bonds

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

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

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

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

ARTICLE 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

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

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

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

<< >>

- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds, unless otherwise stated below.

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

<< >>

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

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

<< >>

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

(Insert the date of the E203-2013.)

<< >>

- .5 Drawings

Number

Title

Date

- .6 Specifications

Section

Title

Date

Pages

.7 Addenda:

Number	Date	Pages

.8 Other Exhibits:

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

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

<< >>

[] The Sustainability Plan:

Title	Date	Pages

[] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents listed below:

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

<< >>

SECTION 003132 – GEOTECHNICAL DATA

PART 1 – GENERAL

1.1 SUMMARY

- A. The Geotechnical Engineering Report for the **Raytown Herndon Restaurant** project, including the boring logs, has been prepared for the Owner by Terracon, and is bound into the Project Manual. The report and boring logs are for background information only and shall not be considered as part of the Contract Documents.
 - 1. Any questions regarding this report should be directed to the Architect.
- B. The Contractor shall account for the existing site conditions in its Bid in consideration of all earthwork, grading, and construction required for the Project as indicated in the Contract Documents.
 - 1. Boring locations and boring logs are included in the reports. The boring logs are for information purposes only and are not intended as representations or warranties of accuracy and continuity between soil borings. The boring logs are not a part of the Contract Documents and are not a warrant of subsurface conditions. The Owner does not warrant the accuracy of the boring logs. Therefore, the Bidders are to make their own investigation of the site.
 - 2. The Site Conditions below grade are noted as unclassified.

1.2 PROJECT CONDITIONS

- A. Bidders shall examine the site and the record of investigations and determine for themselves the existing conditions and the character of the subsurface conditions to be encountered. The owner and Architect do not assume responsibility for subsurface conditions other than at the locations and at the time the borings were made.
- B. Claims for additional costs due to subsurface conditions encountered will not be permitted unless specifically noted otherwise in the Contract Documents.

END OF SECTION 003132



Geotechnical Engineering Report

**Herndon Restaurant
Raytown, Missouri**

April 19, 2018

Terracon Project No. 02185070

Prepared for:

Hollis + Miller Architects
Kansas City, Missouri

Prepared by:

Terracon Consultants, Inc.
Lenexa, Kansas

terracon.com

The Terracon logo, consisting of the word "Terracon" in a white, bold, sans-serif font, set against a dark red rectangular background.

Environmental



Facilities



Geotechnical



Materials

April 19, 2018

Hollis + Miller Architects
1828 Walnut Street, Suite 922
Kansas City, Missouri 64108



Attn: Ms. Sandy Cochran

Re: Geotechnical Engineering Report
Herndon Restaurant
11507 East State Route 350
Raytown, Missouri
Terracon Project No. 02185070

Dear Ms. Cochran:

We have completed a geotechnical exploration for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P02185070, dated March 19, 2018. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

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

Sincerely,

Terracon Consultants, Inc.


Kevin D. Friedrichs, P.E.
Project Engineer
Missouri: PE 2013010325

Kole C. Berg, P.E.
Senior Engineer
Missouri: PE 2002016417



REPORT TOPICS

- INTRODUCTION..... 1**
- SITE CONDITIONS..... 1**
- PROJECT DESCRIPTION..... 2**
- GEOTECHNICAL CHARACTERIZATION..... 2**
- GEOTECHNICAL OVERVIEW 3**
- EARTHWORK 5**
- SHALLOW FOUNDATIONS..... 8**
- SEISMIC CONSIDERATIONS 10**
- FLOOR SLABS 10**
- GENERAL COMMENTS..... 12**

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

ATTACHMENTS

- EXPLORATION AND TESTING PROCEDURES**
- SITE LOCATION AND EXPLORATION PLANS**
- EXPLORATION RESULTS** (Boring Logs and Laboratory Data)
- SUPPORTING INFORMATION** (General Notes, USCS, and Description of Rock Properties)

Geotechnical Engineering Report

Herndon Restaurant
11507 East State Route 350
Raytown, Missouri
Terracon Project No. 02185070
April 19, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering evaluation performed for the proposed Herndon Restaurant to be located at 11507 East State Route 350 in Raytown, Missouri. Three exploratory borings were performed at the site to depths ranging from approximately 9 to 12½ feet below existing site grades. This report describes the subsurface conditions encountered at the boring locations, presents the test data, and provides geotechnical recommendations for the following items:

- earthwork
- foundations
- floor slabs
- seismic site class

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

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available maps.

Item	Description
Project Location	The project is located at 11507 East State Route 350 in Raytown, Missouri.
Existing Improvements	The site is presently occupied by a single story building and asphalt parking lot.

PROJECT DESCRIPTION

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

Item	Description
Proposed Structure	The existing structure will be demolished and a new one-story metal building with a footprint of approximately 6,400 square feet will be constructed in its place. The building will be steel framed with metal building panels and a stone masonry wainscot finish. The floor slab will consist of reinforced concrete with turn-down edges.
Finished Floor Elevation (FFE)	The planned FFE of the structure was not provided. We anticipate the FFE will be within ± 2 feet of existing grades.
Maximum Loads	We have considered the following maximum loads: <ul style="list-style-type: none"> ■ Columns: 60 kips (provided) ■ Walls: 1 kips per linear foot (provided) ■ Slabs: 100 pounds per square foot (estimated)
Grading	A site grading plan was not provided. We have considered up to 2 feet of cut and 2 feet of fill will be required to develop final grades.
Below Grade Structures	No below grade walls or free standing retaining walls are anticipated.
Pavements	No new pavements are planned with the project.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The following table provides our geotechnical characterization.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. As noted in **General Comments**, the characterization is based upon widely spaced borings across the site, and variations are likely.

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Consistency
1a	6 to 7½ inches	Asphalt and Concrete Pavements (B-1 and B-3)	N/A
1b	3 inches	Root Zone Material (B-2)	N/A

Stratum	Approximate Depth to Bottom of Stratum	Material Description	Consistency
2	1.5 to 3 feet	Fill – Lean to fat clay trace gravel	N/A
3	7½ to 8½ feet	Fat Clay (CH)	Soft to stiff
4	Undetermined: Borings terminated within this stratum at auger refusal on Limestone at approximately 9 to 12½ feet.	Shale and/or Limestone Bedrock	Highly weathered

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil and rock types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed during drilling for the presence and level of groundwater. Groundwater was not observed in the boreholes during our subsurface exploration. Long-term observations in piezometers or observation wells, sealed from the influence of surface water, would be needed to develop more detailed groundwater information. Groundwater level fluctuations occur due to variations in rainfall, runoff, and other factors not evident at the time we performed the borings. The potential for groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

Based on conditions encountered at the boring locations, it appears feasible to support the new restaurant building on shallow foundations bearing in native clay soils.

Existing foundations, slabs, pavements, and associated utilities should be removed prior to the construction of the new building. Care should be taken to thoroughly remove all existing improvements that would interfere with the proposed new construction. Excavations created by demolition and removal of existing features should be backfilled with engineered fill that is placed and compacted as recommended in this report. The demolition contractor should be aware of project requirements for complete removal of existing features, observation and testing of the base of demolition excavations prior to backfilling, use of appropriate backfill materials, and proper placement, compaction and testing of backfill materials. This will ensure that removal of the demolition contractor’s backfill materials and replacement under controlled conditions is not necessary when building construction commences.

Geotechnical Engineering Report

Herndon Restaurant ■ Raytown, Missouri

April 19, 2018 ■ Terracon Project No. 02185070



Underground utilities may be present within or near the proposed construction area. If these utilities are to remain in place, we recommend that the backfill be tested by a representative of Terracon at the time of construction. If these utilities are to be relocated, the resulting trenches should be overexcavated, backfilled, and tested in accordance with the recommendations in **Earthwork**.

Fill materials consisting of lean clay and fat clay with varying amounts of gravel were observed at Borings B-1 and B-2 to depths ranging from 1½ to 3 feet below existing ground surface elevations. No documentation concerning when or how the fill was placed was provided for our review. Fill materials that are not placed uniformly with moisture and density control may not perform predictably. Foundations and slabs supported on or above undocumented fill could experience larger-than-normal settlements, resulting in cracking and other damage to the new building. In our opinion, existing fill materials encountered within the new building footprint and extending a minimum of 5 feet laterally outside of the proposed building wall lines should be removed and replaced with engineered fill placed according to the recommended compaction requirements in **Earthwork**. We recommend that new building foundations bear on stiff native clay soils or newly placed engineered fill.

Potentially expansive fat clay soils were encountered at the site. These materials have the potential to shrink and swell with seasonal fluctuations in the soil moisture content. We recommend the floor slabs be supported on at least 24 inches of low volume change (LVC) material. In areas that are currently above or less than 2 feet below the planned bottom of floor slab level, fat clay soils should be undercut to accommodate placement of LVC material. In areas where more than 2 feet of fill will be placed below the bottom-of-floor-slab level, at least the upper 24 inches of new engineered fill should consist of LVC material. Placement of a layer of LVC material below floor slabs, as recommended in this report, will not eliminate all future subgrade volume change and resultant floor slab movements. However, use of an LVC zone should reduce the potential for subgrade volume change. Details regarding the LVC zone are provided in **Earthwork**.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and at least minor cracking in the structure could still occur. The severity of cracking and other cosmetic damage caused by movement of the floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and cosmetic distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request. The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Site preparation, excavation, subgrade preparation and placement of engineered fills should conform to recommendations presented in this section. The recommendations presented for design and construction of earth-supported elements including foundations and slabs are contingent upon the recommendations outlined in this section being followed. We recommend earthwork on this project be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of subgrade preparation, engineered fill, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

Site Preparation

Existing foundations, floor slabs, pavements, sidewalks, crushed stone aggregate, topsoil, existing fill soils, and any loose, soft, or otherwise unsuitable materials should be removed from proposed construction areas. The demolition contractor should be aware of project requirements for complete removal of existing features, observation and testing of the base of demolition excavations prior to backfilling, use of appropriate backfill materials, and proper placement, compaction and testing of backfill materials. This will ensure that removal of the demolition contractor's backfill materials and replacement under controlled conditions is not necessary when building construction commences.

The soils within the planned building area should be further undercut as necessary to accommodate placement of the recommended 24-inch thick LVC layer below floor slabs. The undercut areas should extend a minimum of 5 feet laterally outside the building wall lines. Undercutting to facilitate placement of the LVC layer would not be necessary in areas where more than 2 feet of fill will be placed to develop the floor slab subgrade level.

Following initial stripping and any necessary undercutting, the exposed soils should be proofrolled. A Terracon representative should observe the proofrolling. Proofrolling can be accomplished using a loaded tandem-axle dump truck with a gross weight of at least 20 tons, or similarly loaded equipment. Areas that display excessive deflection (pumping) or rutting during proofroll operations should be improved by scarification/compaction or by removal and replacement with engineered fill.

Fill Material Types

All materials incorporated in engineered fill sections must be free of organic matter and debris. Fill materials should not be frozen and should not be placed on a frozen subgrade. A sample of each material type should be tested prior to being used on the site. Soil is commonly used as fill in this locale, but not all soils are suitable. Our professional opinions concerning suitability of fill materials are presented in the following table.

Suitability as Fill	Description	Unified Soil Classification	
		Group Symbol	Group Name
Suitable	Clean Gravel	GW	Well-graded gravel
		GP	Poorly graded gravel
	Gravel with fines	GM	Silty gravel
		GC	Clayey gravel
	Clean sand	SW	Well-graded sand
		SP	Poorly-graded sand
	Sand with fines	SM	Silty sand
		SC	Clayey sand
	Description	Group Symbol	Group Name
Marginally Suitable¹	Silt	ML	Silt ²
	Clay	CL	Lean clay ³
	Clay	CH	Fat clay ⁴
	Description	Group Symbol	Group Name
Unsuitable	Highly organic soils	MH	Elastic silt
		OL & OH	Organic clay & organic silt
		PT	Peat

1. Depends on location and intended use. Can be used if approved by geotechnical engineer.
2. Highly susceptible to frost action; unstable when wet. Should not be used directly below exterior slabs without prior approval of geotechnical engineer.
3. Can be expansive if dry or if liquid limit is 45 or greater. Requires approval of geotechnical engineer.
4. Expansive. Not recommended immediately below floors and other movement-sensitive features. Must be placed with strict moisture and density control to reduce swell potential.

Low volume change (LVC) material placed below the building floor slabs can consist of well-graded crushed stone aggregate (e.g., MoDOT Type 5). Lean clay with a liquid limit less than 45 and a plasticity index less than 23 could also be used as LVC material, but these soils would be susceptible to softening and disturbance if they become wetted by surface water and precipitation. Soils that meet the LVC criteria were not encountered in the borings. Therefore, the use of imported LVC materials should be expected. If a granular leveling course (such as crushed stone aggregate) is used immediately below the floor slabs, this material can be considered part of the LVC zone.

Fill Compaction Requirements

Item	Description
Lift Thickness (maximum)	9 inches in loose thickness when large, self-propelled compaction equipment is used. 4 inches when small, hand-guided equipment (plate or “jumping jack” compactor) is used.
Minimum Compaction Requirements ¹	At least 95 percent of the material’s maximum dry density ¹
Moisture Content of Clay Soil	LL<45 -2 to +2 percent of optimum moisture content value ¹
	LL>45 0 to 4 percent above the optimum moisture content value ¹
Moisture Content of Granular Material	Sufficient to achieve compaction without pumping when proofrolled

¹. As determined by the standard Proctor test (ASTM D 698)

We recommend that engineered fill be tested for moisture content and compaction during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of clay fill to reduce the infiltration and conveyance of surface water through the trench backfill.

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

Grading and Drainage

During construction, grades should be developed to direct surface water flow away from or around the site. Exposed subgrades should be sloped to provide positive drainage so that saturation of subgrades is avoided. Surface water should not be permitted to accumulate on the site. Final surrounding grades should promote rapid surface drainage away from the building. Accumulation

Geotechnical Engineering Report

Herndon Restaurant ■ Raytown, Missouri

April 19, 2018 ■ Terracon Project No. 02185070



of water adjacent to the building could contribute to significant moisture increases in the subgrade soils and subsequent softening/settlement or expansion/heave.

After construction of the building has been completed, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the building should also be periodically inspected and adjusted as necessary, as part of the building's maintenance program.

Earthwork Construction Considerations

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proofrolling, placement and compaction of controlled compacted fills, backfilling of excavations into completed subgrades, and just prior to construction of foundations and slabs.

Care should be taken to avoid disturbance of prepared subgrades. Unstable subgrade conditions can develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. If unstable subgrade conditions develop, stabilization measures will need to be employed. Construction traffic over the completed subgrade should be avoided to the extent practical. If the subgrade becomes frozen, desiccated, saturated, or disturbed, the affected materials should be removed or these materials should be scarified, moisture conditioned, and compacted prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, state, and federal safety regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed those specified by these safety regulations. Flatter slopes than those dictated by these regulations may be required depending upon the soil conditions encountered and other external factors. These regulations are strictly enforced and if they are not followed, the owner, contractor, and/or earthwork and utility subcontractor could be liable and subject to substantial penalties. Under no circumstances should the information provided in this report be interpreted to mean that Terracon is responsible for construction site safety or the contractor's activities. Construction site safety is the sole responsibility of the contractor who shall also be solely responsible for the means, methods, and sequencing of the construction operations.

SHALLOW FOUNDATIONS

Foundation Design Parameters

Based on the conditions encountered at the borings, the footings for the building are expected to bear on a combination of native clay soils and engineered fill. Footings should not be supported on or above existing undocumented fill materials.

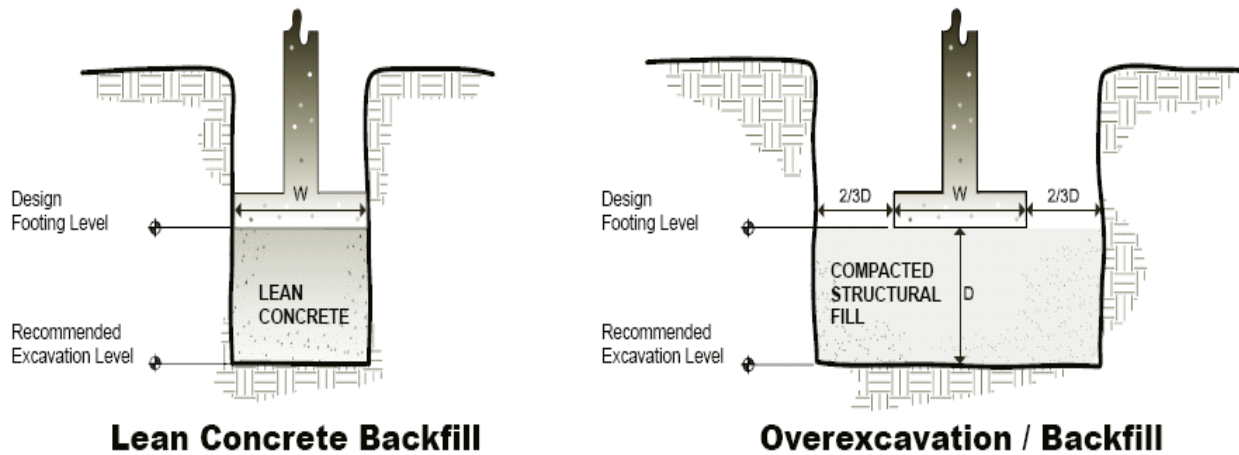
Description	Value
Maximum net allowable bearing pressure ¹	2,000 psf
Minimum embedment below finished grade for frost protection ²	3 feet
Minimum footing widths	Isolated footings: 30 inches Continuous footings: 16 inches
Estimated total settlement ³	1 inch or less
Estimated differential settlement ³	1/2 to 2/3 of the total settlement over a horizontal distance of 50 feet

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This pressure assumes that any soft soils or other unsuitable materials, if encountered, will be undercut and replaced with engineered fill.
2. This embedment depth is recommended for perimeter footings and footings beneath unheated areas to provide frost protection and to reduce the effects of seasonal moisture variations in the foundation bearing soils. Interior footings in heated areas may be supported at shallower depths, provided they are not exposed to freezing conditions during construction.
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of engineered fill below the footings, and the quality of the earthwork operations and footing construction.

Foundation Construction Considerations

The base of all foundation excavations should be free of water and loose materials prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. If the soils at the bearing level become excessively dry, disturbed, saturated, or frozen, the affected soil should be removed prior to placing concrete. If the excavations must remain open overnight or for an extended period of time, placement of a lean concrete mud-mat over the bearing soils should be considered.

All footing bearing surfaces should be observed and tested by Terracon. If unsuitable conditions are encountered, footing excavations should be extended deeper to suitable bearing materials. Footings can bear directly on suitable soils at the lower level or on lean concrete backfill as shown in the following figure. The footings could also bear on properly compacted backfill extending down to suitable soils as shown in the following figure. Overexcavation for compacted engineered fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing elevation. The overexcavation should then be backfilled up to the footing base elevation with well graded granular material (e.g., MoDOT Type 5 aggregate or an approved alternate gradation) placed and compacted as recommended in **Earthwork**.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

SEISMIC CONSIDERATIONS

Code	Site Classification
2012 International Building Code (IBC)	C ¹

- The 2012 International Building Code (IBC) seismic site class definitions are based on average properties of the subsurface profile to a depth of 100 feet. The exploratory borings encountered bedrock at a maximum depth of 8½ feet. Our opinion of site classification is based on data from our subsurface exploration and our knowledge of local geological and geotechnical conditions.

FLOOR SLABS

Floor Slab Design

Item	Description
Floor Slab Support	24 inches of low volume change (LVC) material
Modulus of Subgrade Reaction	100 pounds per square inch per inch of deflection (psi/in or pci) for point loading conditions
Granular Leveling Course Layer Thickness ^{1,2}	4 inches (minimum)

- Well graded crushed stone (e.g., MoDOT Type 5 aggregate) or open-graded crushed stone (e.g., ASTM C33, Size No. 57 aggregate) can be used as the leveling course.
- These granular materials may be considered part of the LVC zone.

Joints should be constructed in slabs at regular intervals as recommended by the American Concrete Institute (ACI) to help control the location of cracks. Joints or any cracks in the floor slab that develop should be sealed with a water-proof, non-extruding compressible compound.

Loads on footings that support structural walls and column loads are typically greater than floor slab loads. Consequently, footings should be expected to settle more than the adjacent floor slabs. The structural engineer should consider the potential for differential movement between foundations and grade-supported floor slabs.

Typically, some increase in the floor slab subgrade moisture content will occur because of gradual accumulation of capillary moisture, which would otherwise evaporate if the floor slab had not been constructed. The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Floor Slab Construction Considerations

If LVC materials consist of clay, the subgrade should be maintained in a relatively moist condition until the floor slab is constructed. If the subgrade becomes desiccated prior to construction of the floor slab, the affected material should be removed or the materials should be scarified, moistened, and compacted. Upon completion of grading operations in the building area, care should be taken to maintain the recommended subgrade moisture content and density prior to construction of the building floor slab.

On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall etc. As a result, the floor slab subgrade soils may not be suitable for placement of the granular course and/or concrete at the time of building construction, and corrective action may be required.

Terracon should evaluate the condition of the floor slab subgrade immediately prior to placement of the granular leveling course and construction of the slab. Particular attention should be paid to areas containing backfilled trenches and high traffic areas that were previously disturbed during construction. Where unsuitable conditions are located within the floor slab subgrade soils, the subgrade should be improved by removing and replacing the affected material with properly compacted fill.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between boring locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

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

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

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

The borings were located in the field by Terracon personnel using a hand-held GPS unit with a horizontal accuracy of ± 10 feet. Ground surface elevations indicated on the boring logs were measured to the nearest $\frac{1}{2}$ foot using a level and grade rod. Elevations were referenced the floor elevation of the existing building.

The borings were drilled with a truck-mounted, rotary drill rig using solid-stem, continuous flight augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using thin-walled tube and split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outside diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. The drill crew backfilled the borings with auger cuttings after completion of drilling/sampling and prior to leaving the site.

The drill crew prepared a field log of each boring to record data including visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The final boring logs included with this report represent the engineer's interpretation of the subsurface conditions at the borings based on field and laboratory data and observation of the samples.

Laboratory Testing

Representative soil samples were tested in the laboratory to measure their natural water content, dry unit weight, unconfined compressive strength, and Atterberg limits. A pocket penetrometer was used to estimate the consistency of selected cohesive samples. The test results are provided on the boring logs included in **Exploration Results**.

The soil samples were classified in the laboratory based on visual observation, texture, plasticity, and the laboratory testing described above. The soil descriptions presented on the boring logs are in accordance with the enclosed General Notes and Unified Soil Classification System (USCS). The estimated USCS group symbols for native soils are shown on the boring logs, and a brief description of the USCS is included in this report.

The bedrock materials encountered in the borings were described in accordance with the appended Description of Rock Properties on the basis of drilling characteristics and visual classification of disturbed auger cuttings. Petrographic analysis and rock core may indicate other rock types.

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION

Herndon Restaurant ■ Raytown, MO

April 12, 2018 ■ Terracon Project No. 02185070

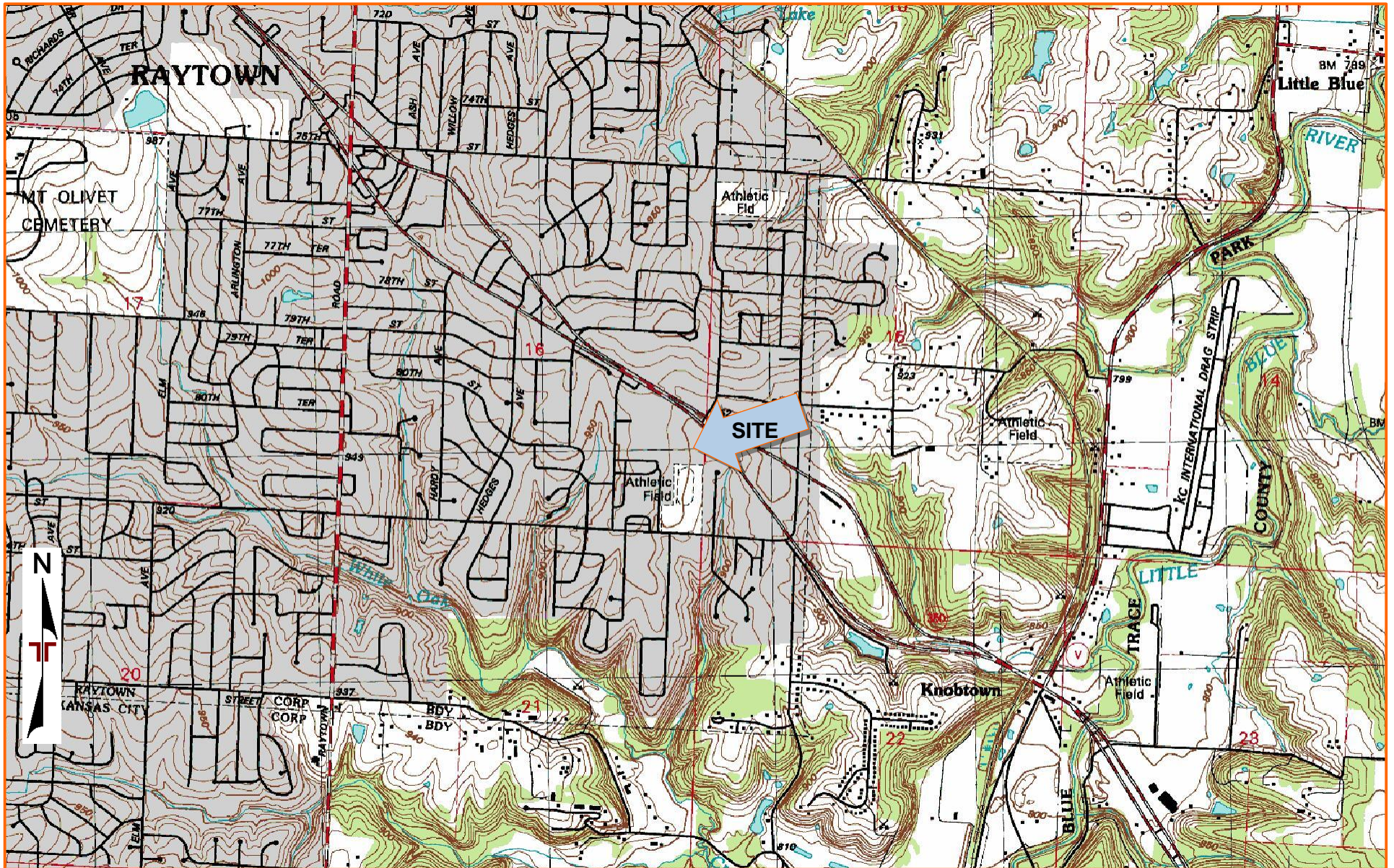


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: LEES SUMMIT, MO (1/1/1996).

EXPLORATION PLAN

Herndon Restaurant ■ Raytown, MO

April 12, 2018 ■ Terracon Project No. 02185070



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

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

BORING LOG NO. B-1

PROJECT: Herndon Restaurant

CLIENT: Hollis & Miller Group
Kansas City, MO

SITE: 11507 East State Route 350
Raytown, MO

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL. 02185070 HERNDON RESTAURAN.GPJ TERRACON DATATEMPLATE.GDT 4/19/18

GRAPHIC LOG	LOCATION See Exploration Plan	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
	Latitude: 38.9755° Longitude: -94.447° Approximate Surface Elev: 99.0 (Ft.) +/- ELEVATION (Ft.)										LL-PL-PI
	6" ASPHALT	0.5									
	FILL - LEAN CLAY , trace gravel, dark brown to brown	3.0				3-4-6 N=10			20		47-21-26
	FAT CLAY (CH) , gray, stiff	8.5						2720	29	93	
	- soft below 6.5 feet										
	LIMESTONE , gray, highly weathered	9.0				50/2"			17		
	Auger Refusal at 9 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual. Hammer Type: Automatic
 Classification of rock materials has been estimated based on observation of disturbed samples. Core samples and/or petrographic analysis may reveal other rock types.

Advancement Method: Continuous Flight Auger	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any). See Supporting Information for explanation of symbols and abbreviations. Elevations were measured in the field using an engineer's level and grade rod.	Notes:
Abandonment Method: Boring backfilled with Auger Cuttings Surface capped with concrete		
WATER LEVEL OBSERVATIONS <i>Groundwater not encountered</i>	<p style="font-size: 0.8em; margin: 0;">13910 W 96th Ter Lenexa, KS</p>	Boring Started: 04-10-2018 Drill Rig: 988 Project No.: 02185070
		Boring Completed: 04-10-2018 Driller: SF

BORING LOG NO. B-2

PROJECT: Herndon Restaurant

CLIENT: Hollis & Miller Group
Kansas City, MO

SITE: 11507 East State Route 350
Raytown, MO

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_02185070 HERNDON RESTAURAN.GPJ TERRACON_DATATEMPLATE.GDT 4/19/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.9756° Longitude: -94.4468° Approximate Surface Elev: 100.0 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
											LL-PL-PI
0.3	3" ROOT ZONE	100+/-									
1.5	FILL - FAT CLAY , trace gravel, brown	98.5+/-									
5.0	FAT CLAY (CH) , brown and gray, stiff			16		4-6-6 N=12			27		50-21-29
5.5				12			2.25		30	95	
8.5	SHALE , light brown, highly to moderately weathered	91.5+/-									
10.0											
12.0	LIMESTONE , gray, highly weathered	88+/-									
12.5	Auger Refusal at 12.5 Feet	87.5+/-									

Stratification lines are approximate. In-situ, the transition may be gradual. Classification of rock materials has been estimated based on observation of disturbed samples. Core samples and/or petrographic analysis may reveal other rock types. Hammer Type: Automatic

<p>Advancement Method: Continuous Flight Auger</p> <p>Abandonment Method: Boring backfilled with auger cuttings upon completion.</p>	<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p> <p>Elevations were measured in the field using an engineer's level and grade rod.</p>	<p>Notes:</p>						
<p>WATER LEVEL OBSERVATIONS <i>Groundwater not encountered</i></p>	<p>13910 W 96th Ter Lenexa, KS</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Boring Started: 04-10-2018</td> <td style="width: 50%;">Boring Completed: 04-10-2018</td> </tr> <tr> <td>Drill Rig: 988</td> <td>Driller: SF</td> </tr> <tr> <td colspan="2">Project No.: 02185070</td> </tr> </table>	Boring Started: 04-10-2018	Boring Completed: 04-10-2018	Drill Rig: 988	Driller: SF	Project No.: 02185070	
Boring Started: 04-10-2018	Boring Completed: 04-10-2018							
Drill Rig: 988	Driller: SF							
Project No.: 02185070								

BORING LOG NO. B-3

PROJECT: Herndon Restaurant

CLIENT: Hollis & Miller Group
Kansas City, MO

SITE: 11507 East State Route 350
Raytown, MO

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_02185070 HERNDON RESTAURAN.GPJ TERRACON_DATATEMPLATE.GDT 4/19/18

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 38.9753° Longitude: -94.4467° Approximate Surface Elev: 99.0 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	HAND PENETROMETER (tsf)	UNCONFINED COMPRESSIVE STRENGTH (psf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS
											LL-PL-PI
	7.5" CONCRETE	0.6									
	3" CRUSHED LIMESTONE	0.9									
	FAT CLAY (CH) , gray, stiff										
	SHALE , with limestone seams, light brown, highly to moderately weathered	7.5				2-4-5 N=9			26		
		5					2.0		28	95	
		10									
		18				6-8-32 N=40			26		
	LIMESTONE , gray, highly weathered	11.0									
		12.0									
	Auger Refusal at 12 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification of rock materials has been estimated based on observation of disturbed samples. Core samples and/or petrographic analysis may reveal other rock types.







Hammer Type: Automatic

<p>Advancement Method: Continuous Flight Auger</p> <p>Abandonment Method: Boring backfilled with Auger Cuttings Surface capped with concrete</p>	<p>See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).</p> <p>See Supporting Information for explanation of symbols and abbreviations.</p> <p>Elevations were measured in the field using an engineer's level and grade rod.</p>	<p>Notes:</p>						
<p>WATER LEVEL OBSERVATIONS <i>Groundwater not encountered</i></p>	 13910 W 96th Ter Lenexa, KS	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Boring Started: 04-10-2018</td> <td style="width: 50%;">Boring Completed: 04-10-2018</td> </tr> <tr> <td>Drill Rig: 988</td> <td>Driller: SF</td> </tr> <tr> <td>Project No.: 02185070</td> <td></td> </tr> </table>	Boring Started: 04-10-2018	Boring Completed: 04-10-2018	Drill Rig: 988	Driller: SF	Project No.: 02185070	
Boring Started: 04-10-2018	Boring Completed: 04-10-2018							
Drill Rig: 988	Driller: SF							
Project No.: 02185070								

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

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

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS	RELATIVE DENSITY OF COARSE-GRAINED SOILS <small>(More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance</small>		CONSISTENCY OF FINE-GRAINED SOILS <small>(50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance</small>		
	Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (psf)	Standard Penetration or N-Value Blows/Ft.
	Very Loose	0 - 3	Very Soft	less than 500	0 - 1
	Loose	4 - 9	Soft	500 to 1,000	2 - 4
	Medium Dense	10 - 29	Medium Stiff	1,000 to 2,000	4 - 8
	Dense	30 - 50	Stiff	2,000 to 4,000	8 - 15
	Very Dense	> 50	Very Stiff	4,000 to 8,000	15 - 30
			Hard	> 8,000	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

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

^A Based on the material passing the 3-inch (75-mm) sieve

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

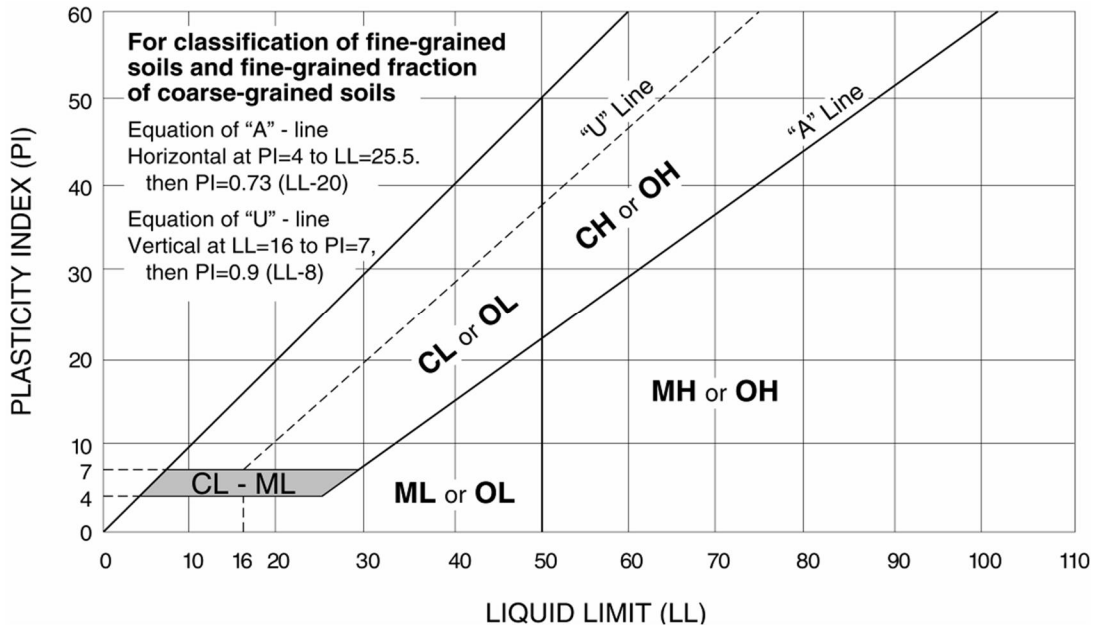
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING

Term	Description
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS

Description	Field Identification	Uniaxial Compressive Strength, PSI (MPa)
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION

Fracture Spacing (Joints, Faults, Other Fractures)		Bedding Spacing (May Include Foliation or Banding)	
Description	Spacing	Description	Spacing
Extremely close	< ¾ in (<19 mm)	Laminated	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	Very thin	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	Thin	2 in – 1 ft (50 – 300 mm)
Moderate	8 in – 2 ft (200 – 600 mm)	Medium	1 ft – 3 ft (300 – 900 mm)
Wide	2 ft – 6 ft (600 mm – 2.0 m)	Thick	3 ft – 10 ft (900 mm – 3 m)
Very Wide	6 ft – 20 ft (2.0 – 6 m)	Massive	> 10 ft (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0 degree angle.

ROCK QUALITY DESIGNATION (RQD*)

Description	RQD Value (%)
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

*The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

PROPOSAL FORM

for
Raytown Herndon Restaurant

GENERAL CONTRACT

Bid to

Board of Education
Raytown Quality Schools
6608 Raytown Road
Raytown, Missouri 64113

Place of Bid Opening

Central Office
6608 Raytown Road
Raytown, Missouri 64133

Bid for

Raytown Quality Schools
Herndon Restaurant

Time of Bid Opening

Tuesday, April 2, 2019, at
2:00 p.m. (Local Time)

Name of Bidder: _____

Address of Bidder: _____

Telephone Number: _____ Fax Number: _____

1. **THE SITE AND THE DOCUMENTS**

We the undersigned, having examined the Contract Documents listed below and the site of the proposed Work and being familiar with all conditions affecting the construction of the Project, hereby propose and agree to provide and furnish all labor, material, equipment, supervision and other items necessary to perform and complete, in a workmanlike manner, all Work required by the Contract Documents, at the prices stated below. Stated sums include fees, insurance, payroll taxes, and all other charges applicable to materials, appliances, labor and all charges that may be levied. This Bid excludes sales tax.

- (a) Instructions to Bidders, AIA Document A701
- (b) Supplementary Instructions to Bidders
- (c) General Conditions of the Contract, AIA Document A201
- (d) Supplementary General Conditions
- (e) Subsurface Soils Information
- (f) Prevailing Wage Determination
- (g) Specifications (as listed in the Specification Table of Contents)
- (h) Drawings (sets entitled) <<Insert Project Title(s)>>
- (i) Addenda issued during the Time of Bidding
(Numbered _____, _____, _____, _____ and _____).

2. THE AMOUNT OF THE BASE BID FOR RAYTOWN HERNDON RESTAURANT

We propose to furnish all materials and labor for the **Raytown Quality Schools – Herndon Restaurant** called for by the above Documents for the Base Bid work for the total sum of:

Dollars and _____ Cents (\$ _____).

BID BREAKDOWN

Pricing for **Metal Building Package ONLY** (including all related materials) called for by the above Documents for the Base Bid work for the total sum of:

Dollars and _____ Cents (\$ _____).

3. THE AMOUNT OF THE ALLOWANCES

We, the undersigned, propose to include in the base Bid amount the following allowances, which include all labor and material as called for by the above documents.

~~ALLOWANCE NO. 1 – Baseball/Softball Scoreboard \$50,000.00~~

4. AMOUNTS FOR UNIT PRICES

Not Used.

5. AMOUNT OF ALTERNATES

We, the undersigned, propose to furnish all materials, labor, plant and appurtenances called for by the above documents for the Alternates for the following sums and to allow for the Owner a period of sixty (60) days from the date of Contract Award to accept or reject the Alternates without change in the Alternate Amount or Contract Time. Circle "Add" or "Deduct" as it applies for each Alternate. Refer to Section 012300 ALTERNATES.

SCHEDULE OF ALTERNATES:

~~Alternate No. 1 – Pressbox at Raytown South High School (\$ _____)Add~~

~~Alternate No. 2 – Dugouts at Raytown South High School (\$ _____)Add~~

8. MANUFACTURERS/SUPPLIERS

We propose to utilize the following Manufacturers/Suppliers as part of our Base Bid Proposal:

RESINOUS TOPPINGS

CARPET

MANUFACTURER

MANUFACTURER

SYSTEM NAME

CARPET TILE NAME/STYLE

CARPET TILE COLOR

9. COMPLETION OF THE WORK

If we are notified of the acceptance of the Base Bid of this Proposal within sixty (60) days after the above date, we agree to execute a Contract for the above Work, for the above stated compensation in the form of the Standard Agreement Between Owner and Contractor (Stipulated Sum) AIA Document A101, of the American Institute of Architects, as modified by the Owner. We further agree to meet the date established for Substantial Completion and Final Completion as set forth in the Bidding Documents and agree to pay as liquidated damages the sum of Five Hundred Dollars (\$500.00) for each consecutive calendar day thereafter that the Work remains incomplete.

The Undersigned hereby agrees to commence work under the Contract within twenty-four hours after written notice is given that a portion of this Contractor's work is ready.

9. BID SECURITY

Bidders whose Bid includes both labor and materials and whose Base Bid amount is \$5,000.00 or greater, agrees to and has attached hereto a Bid Bond for the amount of five percent (5%) of the amount of the Bid submitted.

This Bid Security is to be left in escrow with the Architect. If the Undersigned defaults in executing the Agreement within three (3) days of written notification of the award of the Contract to him, or in furnishing the Performance Bond within fourteen (14) days thereafter, the Bid Security will become the property of the Owner and will be delivered to him by the Architect. If the Undersigned executes and delivers the Agreement and Bond within the time specified, or if the Base Bid of this Proposal is not accepted within sixty (60) days of the time set for submission of Bids, the Bid Security shall be returned to the Contractor upon delivery of a receipt therefore.

If the Undersigned defaults in executing and delivering the above-named Agreement and the required performance Bond, the Owner would sustain liquidated damages for five percent (5%) of the amount of the Bid submitted, the measure of which is the amount of the accompanying Bid Bond, Certified Check, or Cashier's Check, payable to "Raytown Quality Schools".

We the undersigned, acknowledge and agree that the owner reserves the right to waive and informalities in any Bid and to reject any and all Bids.

The undersigned Bidder, on behalf of itself and all sub-bidders, releases the Owner, Architect, Construction Manager and other Bidders from any claim arising out of or relating to the acceptance, non-acceptance, or rejection of the undersigned's or any other Bidder's Bid, including without limitation Bids of its sub-bidders, on this Project.

NOTE: If the Contractor is a Corporation, Proposal must be signed by an authorized officer, showing his title.

Yours very truly,

Corporate Seal

FIRM

ADDRESS

TELEPHONE: _____

FAX: _____

BY: _____

TITLE: _____

STATE OF INCORPORATION: _____

Notary Seal

Notary Public

STATE OF _____

COUNTY OF _____

My Commission Expires: _____

DOCUMENT 004313 - BID SECURITY FORMS

1.1 PROPOSAL FORM SUPPLEMENT

- A. A completed bid bond form is required to be attached to the Proposal Form.

1.2 BID BOND FORM

- A. The Form of the bid security shall be American Institute of Architects (AIA), Document A310 – 2010 “Bid Bond”. A copy of the Bid Bond form is bound hereinafter for information only and may not be duplicated.
- B. Additional copies of the Bid Bond may be obtained, at cost, from the Local Chapter, of the American Institute of Architects, at the address listed below:

AIA Kansas City
1801 McGee, Suite 100
Kansas City, Missouri 64108
Telephone: (816) 221-3485.
www.aiakc.org

- C. Additional copies of the Bid Bond may also be obtained, at cost, from the website of the American Institute of Architects, at the internet address listed below:
 - 1. Website: <http://www.aia.org/contractdocs/index.htm>

END OF DOCUMENT 004313

Bid Bond

CONTRACTOR:

(Name, legal status and address)

<< >><< >>
<< >>

SURETY:

(Name, legal status and principal place of business)

<< >><< >>
<< >>

OWNER:

(Name, legal status and address)

<< >><< >>
<< >>

BOND AMOUNT: \$ << >>

PROJECT:

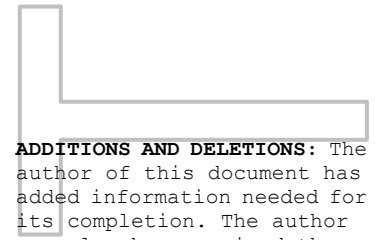
(Name, location or address, and Project number, if any)

<< >>
<< >>
<< >>

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

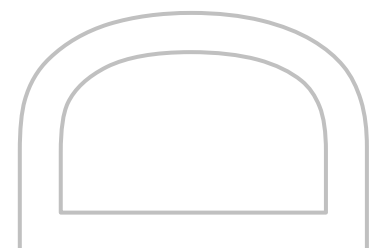
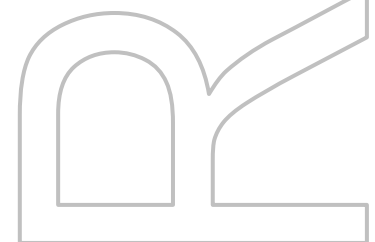
When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.



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

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

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.



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

Signed and sealed this « » day of « », « »

(Witness)

(Witness)

« »

(Contractor as Principal) (Seal)

« »

(Title)

« »

(Surety) (Seal)

« »

(Title)



DOCUMENT 004513 – CONTRACTOR’S QUALIFICATION STATEMENT

1.1 CONTRACTOR’S QUALIFICATION STATEMENT

- A. The form of the Contractor’s Qualifications shall be American Institute of Architects (AIA) Document A305 – 1986 “Contractor’s Qualification Statement”. A copy of the Contractor’s Qualification Statement is bound hereinafter for information only and may not be duplicated.
 - 1. Contractors are to provide a minimum of three references of major projects completed within the past five years. Refer to paragraph 3.5 of AIA Document A305.
- B. Additional copies of the Contractor’s Qualification Statement may be obtained, at cost, from the Local Chapter, of the American Institute of Architects, at the address listed below:

AIA Kansas City
1801 McGee, Suite 100
Kansas City, Missouri 64108
Telephone: (816) 221-3485.
www.aiakc.org

Additional copies of the Contractor’s Qualification Statement may also be obtained, at cost, from the website of the American Institute of Architects, at the internet address listed below:

- 1. Website: <http://www.aia.org/contractdocs/index.htm>

END OF DOCUMENT 004513

DRAFT AIA® Document A305™ – 1986

Contractor's Qualification Statement

The Undersigned certifies under oath that the information provided herein is true and sufficiently complete so as not to be misleading.

SUBMITTED TO: <>

ADDRESS: <>

SUBMITTED BY: <>

NAME: <>

ADDRESS: <>

PRINCIPAL OFFICE: <>

[<>] Corporation

[<>] Partnership

[<>] Individual

[<>] Joint Venture

[<>] Other <>

NAME OF PROJECT: (if applicable) <>

TYPE OF WORK: (file separate form for each Classification of Work)

[<>] General Construction

[<>] HVAC

[<>] Electrical

[<>] Plumbing

[<>] Other: (Specify) <>

§ 1 ORGANIZATION

§ 1.1 How many years has your organization been in business as a Contractor? <>

§ 1.2 How many years has your organization been in business under its present business name? <>

§ 1.2.1 Under what other or former names has your organization operated?

<>

§ 1.3 If your organization is a corporation, answer the following:

§ 1.3.1 Date of incorporation: <>

§ 1.3.2 State of incorporation: <>

§ 1.3.3 President's name: <>

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

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

This form is approved and recommended by the American Institute of Architects (AIA) and The Associated General Contractors of America (AGC) for use in evaluating the qualifications of contractors. No endorsement of the submitting party or verification of the information is made by AIA or AGC.

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

§ 1.3.4 Vice-president's name(s)

<< >>

§ 1.3.5 Secretary's name: << >>

§ 1.3.6 Treasurer's name: << >>

§ 1.4 If your organization is a partnership, answer the following:

§ 1.4.1 Date of organization: << >>

§ 1.4.2 Type of partnership (if applicable): << >>

§ 1.4.3 Name(s) of general partner(s)

<< >>

§ 1.5 If your organization is individually owned, answer the following:

§ 1.5.1 Date of organization: << >>

§ 1.5.2 Name of owner:

<< >>

§ 1.6 If the form of your organization is other than those listed above, describe it and name the principals:

<< >>

§ 2 LICENSING

§ 2.1 List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable.

<< >>

§ 2.2 List jurisdictions in which your organization's partnership or trade name is filed.

<< >>

§ 3 EXPERIENCE

§ 3.1 List the categories of work that your organization normally performs with its own forces.

<< >>

§ 3.2 Claims and Suits. (If the answer to any of the questions below is yes, please attach details.)

§ 3.2.1 Has your organization ever failed to complete any work awarded to it?

<< >>

§ 3.2.2 Are there any judgments, claims, arbitration proceedings or suits pending or outstanding against your organization or its officers?

<< >>

§ 3.2.3 Has your organization filed any law suits or requested arbitration with regard to construction contracts within the last five years?

<< >>

§ 3.3 Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? (If the answer is yes, please attach details.)

<< >>

§ 3.4 On a separate sheet, list major construction projects your organization has in progress, giving the name of project, owner, architect, contract amount, percent complete and scheduled completion date.

<< >>

§ 3.4.1 State total worth of work in progress and under contract:

<< >>

§ 3.5 On a separate sheet, list the major projects your organization has completed in the past five years, giving the name of project, owner, architect, contract amount, date of completion and percentage of the cost of the work performed with your own forces.

<< >>

§ 3.5.1 State average annual amount of construction work performed during the past five years:

<< >>

§ 3.6 On a separate sheet, list the construction experience and present commitments of the key individuals of your organization.

<< >>

§ 4 REFERENCES

§ 4.1 Trade References:

<< >>

§ 4.2 Bank References:

<< >>

§ 4.3 Surety:

§ 4.3.1 Name of bonding company:

<< >>

§ 4.3.2 Name and address of agent:

<< >>

§ 5 FINANCING

§ 5.1 Financial Statement.

§ 5.1.1 Attach a financial statement, preferably audited, including your organization's latest balance sheet and income statement showing the following items:

Current Assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses);

Net Fixed Assets;

Other Assets;

Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes);

Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

§ 5.1.2 Name and address of firm preparing attached financial statement, and date thereof:

<< >>

§ 5.1.3 Is the attached financial statement for the identical organization named on page one?

<< >>

§ 5.1.4 If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidiary).

<< >>

§ 5.2 Will the organization whose financial statement is attached act as guarantor of the contract for construction?

<< >>

§ 6 SIGNATURE

§ 6.1 Dated at this << >> day of << >> << >>

Name of Organization: << >>

By: << >>

Title: << >>

§ 6.2

<< >>

M << >> being duly sworn deposes and says that the information provided herein is true and sufficiently complete so as not to be misleading.

Subscribed and sworn before me this << >> day of << >> << >>

Notary Public: << >>

My Commission Expires: << >>

DOCUMENT 005200 – AGREEMENT FORM

1.1 OWNER AND CONTRACTOR AGREEMENT

- A. The form of the agreement shall be American Institute of Architects (AIA) Document A101 – 2007, “Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum”. The “agreement” is included by reference.
- B. A copy of AIA Document A101 – 2007 may be obtained, at cost, from the Local Chapter, of the American Institute of Architects, at the address listed below:

AIA Kansas City
1801 McGee, Suite 100
Kansas City, Missouri 64108
Telephone: (816) 221-3485.
www.aiakc.org

Copies of AIA Document A101 – 2007 may also be obtained, at cost, from the website of the American Institute of Architects, at the internet address listed below:

1. Website: <http://www.aia.org/contractdocs/index.htm>

1.2 OWNER AND CONTRACTOR AGREEMENT REVISIONS

- A. Section 6.2 Binding Dispute Resolution. For any claims subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201-2007, the method of binding dispute resolution shall be as follows:
 1. Litigation in a court of competent jurisdiction
- B. Section 8.6 Other Provisions:
- C. Section 8.6.1. This Agreement shall be based upon the required payment by the Contractor of not less than the prevailing hourly rate of wages for each craft or type of workmen required to execute the Contract determined by the Department of Labor and Industrial Relations of Missouri.
- D. Section 8.6.2. Prior to commencement of the work, Contractor shall provide to Owner a sworn affidavit and other sufficient documentation to affirm its enrollment and participation in a federal work authorization program with respect to the employees working in connection with this Contract. Contractor shall provide to Owner a sworn affidavit affirming that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services.
- E. Section 8.6.3. As a condition of the Contract, Contractor must provide a 10-hour Occupational Safety and Health Administration (OSHA) construction safety program (“Program”) for Contractors on site employees as mandated by Section 292.675, RSMo. Said Program must include a course in construction safety and health approved by OSHA or a similar program approved by the Missouri Department of Labor and Industrial Relations. This requirement includes the following:
 - F. 8.6.3.1 All of Contractor’s on site employees must complete the Program within 60 days of beginning work on the Project;
 - G. 8.6.3.2 Any employee found on the work site subject to this requirement without documentation of the successful completion of the Program will be given 20 days to produce such documentation before being subject to removal from the Project;
 - H. 8.6.3.3 Contractor’s failure to comply with these requirements will subject it to penalties. Contractor shall forfeit as a penalty to the Owner \$2,500.00 plus \$100.00 for each employee employed by Contractor or Contractor’s subcontractor, for each calendar day, or portion thereof, such employee is employed to do work pursuant to this Contract without the required training. Said penalty shall not begin to accrue until the time period in subsections 8.6.4.1 and 8.6.4.2 have elapsed. Contractor will be subject to said penalties notwithstanding any other provision to the contrary in this Contract.

- I. 8.6.3.4 Contractor shall require its Contracts with all subcontractors to contain these provisions. Contractor shall be responsible for penalties to Owner due to any subcontractor's employees' failure to be able to produce documentary evidence of training in the required program. Contractor may withhold all sums necessary to cover any penalty Owner has withheld or been paid. Contractor may recover any penalties from subcontractor by filing a lawsuit in the Circuit Court of Jackson County, Missouri. Contractor shall have no right of recovery against Owner.
- J. Section 8.6.4. Contractor shall provide documentation proving that all of its employees working on the Project have passed all applicable criminal background checks required by Owner before entering the Owner's premises.
- K. Section 8.6.5. This Contract is to be governed by the laws of the state of Missouri. Venue of any lawsuit filed regarding the Project or arising out of this Contract will be in the Circuit Court of Jackson County, Missouri.
- L. Section 8.6.6. Contractor shall provide Owner with evidence of its establishment and implementation of a random drug and alcohol testing program in conformance with § 161.371 RSMo.

END OF DOCUMENT 005200

DRAFT AIA® Document A101™ – 2017

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

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

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

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.

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

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

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

TABLE OF ARTICLES

- 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.)

« »

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.)

[<< >>] 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)

« »« »

(Printed name and title)

CONTRACTOR (Signature)

« »« »

(Printed name and title)

DOCUMENT 006273 – APPLICATION AND CERTIFICATE FOR PAYMENT

1.1 APPLICATION AND CERTIFICATE FOR PAYMENT

- A. The Form of the Application and Certificate for Payment shall be AIA Document G702 – 1992 “Application and Certification for Payment” and G703 – 1992 “Continuation Sheet. A copy of each form is bound hereinafter for information only and may not be duplicated.
- B. Additional copies of AIA Document G702 and AIA Document G703 may be obtained, at cost, from the Local Chapter, of the American Institute of Architects, at the address listed below:

AIA Kansas City
1801 McGee, Suite 100
Kansas City, Missouri 64108
Telephone: (816) 221-3485.
www.aiakc.org

- C. Additional copies of AIA Document G702 and AIA Document G703 may also be obtained, at cost, from the website of the American Institute of Architects, at the internet address listed below:
 - 1. Website: <http://www.aia.org/contractdocs/index.htm>

END OF DOCUMENT 006273

DOCUMENT 006275 – PARTIAL LIEN WAIVERS

1.1 PARTIAL LIEN WAIVER

- A. The Form of the Partial Lien Waiver is bound hereinafter for Contractor's use and duplication.

END OF DOCUMENT 006275

PARTIAL LIEN WAIVER

Reference that certain Agreement between _____, as Contractor, and Raytown Quality Schools of Raytown, Missouri in Jackson County as Owner, dated on the Project know as: **Raytown Quality Schools – Herndon Restaurant, Project No. 17048**, for work to be performed by said Contractor.

Reference also that certain Invoice (s) No(s). _____ of Contractor to said Owner in the amount of \$ _____ for work, labor, and materials installed in or furnished for said Project as of _____, 20_____.

Upon receipt of the Owner’s remittance for the amount of said invoice(s) and contingent upon the final clearance and payment of said remittance, Contractor agrees to and does hereby waive and release said property, Project and Owner from any and all liens, statutory or otherwise, for any and all work, labor and materials furnished by or through _____ Contractor on said Project to and including the work, labor, and materials covered by said above numbered invoice(s) except for unpaid retainage.

The remittance of the Owner’s identified as payment of said above numbered invoice(s) as endorsed by Contractor marked “paid” or otherwise canceled by the bank against which said remittance was drawn shall constitute conclusive proof that said Invoice(s) were paid and that payment thereof was received by Contractor and this lien waiver shall become effective automatically and without requirement of any further act, acknowledgement or receipt on the part of the Contractor named herein.

Dated this _____ Day of _____, 20_____.

_____ By

_____ Title

Notary Seal (Below)

Notary Public

Subscribed and sworn to before me within and for
STATE OF _____

COUNTY OF _____

On this _____ Day of _____, 20_____

My Commission Expires: _____

DOCUMENT 006276 – BAILMENT RECIEPT

1.1 BAILMENT RECIEPT

- A. The Form of the Bailment Receipt is bound hereinafter for Contractor’s use and duplication.

END OF DOCUMENT 006276

NON-NEGOTIABLE BAILMENT RECEIPT

Receipt No. _____

BAILOR: Raytown Quality Schools
6608 Raytown Road
Raytown, MO. 64113

BAILEE: _____
Contractor / Supplier

PROJECT: Raytown Herndon Restaurant

LOCATION OF STORAGE: _____

The goods and materials described below are held and stored pursuant to the Contract by and between Bailee, as Contractor/Supplier, and Raytown Quality Schools of Raytown, Missouri in Jackson County as Owner, for Work to be performed at the above referenced Project Location. Said goods and materials are to be transferred or delivered to the Project site in conjunction with the performance of Bailee’s Contract referenced above or upon the direction of Bailor or its General Contractor and no other. The Bailee acknowledges that it has not ownership rights or title in, nor shall claim any lien upon, said goods and materials.

<u>QUANTITY</u>	<u>DESCRIPTION OF ITEM</u>
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Received and Acknowledged by:

Contractor / Supplier (Bailee)

On this _____ Day of _____, 20_____

DOCUMENT 006277 – BILL OF SALE

1.1 BILL OF SALE

- A. The Form of the Bill of Sale is bound hereinafter for Contractor's use and duplication.

END OF DOCUMENT 006277

BILL OF SALE

SELLER: _____, Subcontractor or Supplier
_____, Address
_____, City, State Zip

In consideration of payments made pursuant to its Contract with Raytown Quality Schools in Jackson County as Owner, Buyer, dated _____, 20__ for the Project known as Raytown Herndon Restaurant, receipt of which is hereby acknowledged, Seller does hereby grant, sell, transfer, and deliver to Buyer right, title, and interest in the following goods:

Buyer shall have all rights and title to the goods in himself and his executors, administrators and assigns. Seller is the lawful owner of the goods and the goods are free from all encumbrances. Seller has good right to sell the goods and will warrant and defend the right against the lawful claims and demands of all persons. It is expressly understood and agreed that the acceptance of the goods described herein is not a waiver of any right of action that the Buyer may have for breach of warranty of any other cause under the Contract referenced above or at law.

In Witness Whereof, Seller has executed this Agreement the _____ day of _____, 20_____.

Seller: _____ (subcontractor, supplier)

By: _____

Title: _____

ASSIGNMENT OF BILL OF SALE

_____, in consideration of payments made by _____, Owner, pursuant to its Contract dated _____, 20_____ for the project known as _____ does hereby assign this Bill of Sale to Owner.

By: _____

Title: _____

Date: _____

DOCUMENT 007200 – GENERAL CONDITIONS

1.1 APPLICABLE DOCUMENTS

- A. The American Institute of Architects Document A201, “General Conditions of the Contract for Construction”, 2007 Edition, is part of the Contract Documents and is included hereinafter, as amended.

END OF DOCUMENT 007200

DRAFT 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)

<< >>< >>
<< >>

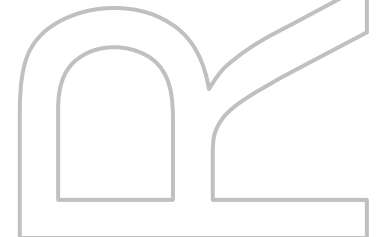
TABLE OF ARTICLES

- | | |
|----|--------------------------------------------------|
| 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.

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.



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

INDEX

(Topics and numbers in bold are Section headings.)

Acceptance of Nonconforming Work

9.6.6, 9.9.3, **12.3**

Acceptance of Work

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

Access to Work

3.16, 6.2.1, 12.1

Accident Prevention

10

Acts and Omissions

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

Addenda

1.1.1

Additional Costs, Claims for

3.7.4, 3.7.5, 10.3.2, 15.1.5

Additional Inspections and Testing

9.4.2, 9.8.3, 12.2.1, **13.4**

Additional Time, Claims for

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

Administration of the Contract

3.1.3, **4.2**, 9.4, 9.5

Advertisement or Invitation to Bid

1.1.1

Aesthetic Effect

4.2.13

Allowances

3.8

Applications for Payment

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

Approvals

2.1.1, 2.3.1, 2.5, 3.1.3, 3.10.2, 3.12.8, 3.12.9,
3.12.10.1, 4.2.7, 9.3.2, 13.4.1

Arbitration

8.3.1, 15.3.2, **15.4**

ARCHITECT

4

Architect, Definition of

4.1.1

Architect, Extent of Authority

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

Architect, Limitations of Authority and Responsibility

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

Architect's Additional Services and Expenses

2.5, 12.2.1, 13.4.2, 13.4.3, 14.2.4

Architect's Administration of the Contract

3.1.3, 3.7.4, 15.2, 9.4.1, 9.5

Architect's Approvals

2.5, 3.1.3, 3.5, 3.10.2, 4.2.7

Architect's Authority to Reject Work

3.5, 4.2.6, 12.1.2, 12.2.1

Architect's Copyright

1.1.7, 1.5

Architect's Decisions

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

Architect's Inspections

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

Architect's Instructions

3.2.4, 3.3.1, 4.2.6, 4.2.7, 13.4.2

Architect's Interpretations

4.2.11, 4.2.12

Architect's Project Representative

4.2.10

Architect's Relationship with Contractor

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

Architect's Relationship with Subcontractors

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

Architect's Representations

9.4.2, 9.5.1, 9.10.1

Architect's Site Visits

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

Asbestos

10.3.1

Attorneys' Fees

3.18.1, 9.6.8, 9.10.2, 10.3.3

Award of Separate Contracts

6.1.1, 6.1.2

Award of Subcontracts and Other Contracts for Portions of the Work

5.2

Basic Definitions

1.1

Bidding Requirements

1.1.1

Binding Dispute Resolution

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

Bonds, Lien

7.3.4.4, 9.6.8, 9.10.2, 9.10.3

Bonds, Performance, and Payment

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

Building Information Models Use and Reliance

1.8

Building Permit

3.7.1

Capitalization

1.3

Certificate of Substantial Completion

9.8.3, 9.8.4, 9.8.5

Certificates for Payment

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

Certificates of Inspection, Testing or Approval

13.4.4

Certificates of Insurance
9.10.2
Change Orders
1.1.1, 3.4.2, 3.7.4, 3.8.2.3, 3.11, 3.12.8, 4.2.8, 5.2.3,
7.1.2, 7.1.3, **7.2**, 7.3.2, 7.3.7, 7.3.9, 7.3.10, 8.3.1,
9.3.1.1, 9.10.3, 10.3.2, 11.2, 11.5, 12.1.2
Change Orders, Definition of
7.2.1
CHANGES IN THE WORK
2.2.2, 3.11, 4.2.8, **7**, 7.2.1, 7.3.1, 7.4, 8.3.1, 9.3.1.1,
11.5
Claims, Definition of
15.1.1
Claims, Notice of
1.6.2, 15.1.3
CLAIMS AND DISPUTES
3.2.4, 6.1.1, 6.3, 7.3.9, 9.3.3, 9.10.4, 10.3.3, **15**, 15.4
Claims and Timely Assertion of Claims
15.4.1
Claims for Additional Cost
3.2.4, 3.3.1, 3.7.4, 7.3.9, 9.5.2, 10.2.5, 10.3.2, **15.1.5**
Claims for Additional Time
3.2.4, 3.3.1, 3.7.4, 6.1.1, 8.3.2, 9.5.2, 10.3.2, **15.1.6**
Concealed or Unknown Conditions, Claims for
3.7.4
Claims for Damages
3.2.4, 3.18, 8.3.3, 9.5.1, 9.6.7, 10.2.5, 10.3.3, 11.3,
11.3.2, 14.2.4, 15.1.7
Claims Subject to Arbitration
15.4.1
Cleaning Up
3.15, 6.3
Commencement of the Work, Conditions Relating to
2.2.1, 3.2.2, 3.4.1, 3.7.1, 3.10.1, 3.12.6, 5.2.1, 5.2.3,
6.2.2, 8.1.2, 8.2.2, 8.3.1, 11.1, 11.2, **15.1.5**
Commencement of the Work, Definition of
8.1.2
Communications
3.9.1, **4.2.4**
Completion, Conditions Relating to
3.4.1, 3.11, 3.15, 4.2.2, 4.2.9, 8.2, 9.4.2, 9.8, 9.9.1,
9.10, 12.2, 14.1.2, 15.1.2
COMPLETION, PAYMENTS AND
9
Completion, Substantial
3.10.1, 4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1,
9.10.3, 12.2, 15.1.2
Compliance with Laws
2.3.2, 3.2.3, 3.6, 3.7, 3.12.10, 3.13, 9.6.4, 10.2.2, 13.1,
13.3, 13.4.1, 13.4.2, 13.5, 14.1.1, 14.2.1.3, 15.2.8,
15.4.2, 15.4.3
Concealed or Unknown Conditions
3.7.4, 4.2.8, 8.3.1, 10.3
Conditions of the Contract
1.1.1, 6.1.1, 6.1.4
Consent, Written
3.4.2, 3.14.2, 4.1.2, 9.8.5, 9.9.1, 9.10.2, 9.10.3, 13.2,
15.4.4.2

Consolidation or Joinder
15.4.4
CONSTRUCTION BY OWNER OR BY
SEPARATE CONTRACTORS
1.1.4, **6**
Construction Change Directive, Definition of
7.3.1
Construction Change Directives
1.1.1, 3.4.2, 3.11, 3.12.8, 4.2.8, 7.1.1, 7.1.2, 7.1.3, **7.3**,
9.3.1.1
Construction Schedules, Contractor's
3.10, 3.11, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2
Contingent Assignment of Subcontracts
5.4, 14.2.2.2
Continuing Contract Performance
15.1.4
Contract, Definition of
1.1.2
CONTRACT, TERMINATION OR
SUSPENSION OF THE
5.4.1.1, 5.4.2, 11.5, **14**
Contract Administration
3.1.3, 4, 9.4, 9.5
Contract Award and Execution, Conditions Relating
to
3.7.1, 3.10, 5.2, 6.1
Contract Documents, Copies Furnished and Use of
1.5.2, 2.3.6, 5.3
Contract Documents, Definition of
1.1.1
Contract Sum
2.2.2, 2.2.4, 3.7.4, 3.7.5, 3.8, 3.10.2, 5.2.3, 7.3, 7.4,
9.1, 9.2, 9.4.2, 9.5.1.4, 9.6.7, 9.7, 10.3.2, 11.5, 12.1.2,
12.3, 14.2.4, 14.3.2, 15.1.4.2, **15.1.5**, **15.2.5**
Contract Sum, Definition of
9.1
Contract Time
1.1.4, 2.2.1, 2.2.2, 3.7.4, 3.7.5, 3.10.2, 5.2.3, 6.1.5,
7.2.1.3, 7.3.1, 7.3.5, 7.3.6, 7, 7, 7.3.10, 7.4, 8.1.1,
8.2.1, 8.2.3, 8.3.1, 9.5.1, 9.7, 10.3.2, 12.1.1, 12.1.2,
14.3.2, 15.1.4.2, 15.1.6.1, 15.2.5
Contract Time, Definition of
8.1.1
CONTRACTOR
3
Contractor, Definition of
3.1, **6.1.2**
Contractor's Construction and Submittal
Schedules
3.10, 3.12.1, 3.12.2, 4.2.3, 6.1.3, 15.1.6.2
Contractor's Employees
2.2.4, 3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2,
10.3, 11.3, 14.1, 14.2.1.1
Contractor's Liability Insurance
11.1
Contractor's Relationship with Separate Contractors
and Owner's Forces
3.12.5, 3.14.2, 4.2.4, 6, 11.3, 12.2.4

Contractor's Relationship with Subcontractors
1.2.2, 2.2.4, 3.3.2, 3.18.1, 3.18.2, 4.2.4, 5, 9.6.2, 9.6.7, 9.10.2, 11.2, 11.3, 11.4

Contractor's Relationship with the Architect
1.1.2, 1.5, 2.3.3, 3.1.3, 3.2.2, 3.2.3, 3.2.4, 3.3.1, 3.4.2, 3.5.1, 3.7.4, 3.10, 3.11, 3.12, 3.16, 3.18, 4.2, 5.2, 6.2.2, 7, 8.3.1, 9.2, 9.3, 9.4, 9.5, 9.7, 9.8, 9.9, 10.2.6, 10.3, 11.3, 12, 13.4, 15.1.3, 15.2.1

Contractor's Representations
3.2.1, 3.2.2, 3.5, 3.12.6, 6.2.2, 8.2.1, 9.3.3, 9.8.2

Contractor's Responsibility for Those Performing the Work
3.3.2, 3.18, 5.3, 6.1.3, 6.2, 9.5.1, 10.2.8

Contractor's Review of Contract Documents
3.2

Contractor's Right to Stop the Work
2.2.2, 9.7

Contractor's Right to Terminate the Contract
14.1

Contractor's Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 9.2, 9.3, 9.8.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3

Contractor's Superintendent
3.9, 10.2.6

Contractor's Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 7.3.6, 8.2, 10, 12, 14, 15.1.4

Coordination and Correlation
1.2, 3.2.1, 3.3.1, 3.10, 3.12.6, 6.1.3, 6.2.1

Copies Furnished of Drawings and Specifications
1.5, 2.3.6, 3.11

Copyrights
1.5, **3.17**

Correction of Work
2.5, 3.7.3, 9.4.2, 9.8.2, 9.8.3, 9.9.1, 12.1.2, **12.2**, 12.3, 15.1.3.1, 15.1.3.2, 15.2.1

Correlation and Intent of the Contract Documents
1.2

Cost, Definition of
7.3.4

Costs
2.5, 3.2.4, 3.7.3, 3.8.2, 3.15.2, 5.4.2, 6.1.1, 6.2.3, 7.3.3.3, 7.3.4, 7.3.8, 7.3.9, 9.10.2, 10.3.2, 10.3.6, 11.2, 12.1.2, 12.2.1, 12.2.4, 13.4, 14

Cutting and Patching
3.14, 6.2.5

Damage to Construction of Owner or Separate Contractors
3.14.2, 6.2.4, 10.2.1.2, 10.2.5, 10.4, 12.2.4

Damage to the Work
3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.4, 12.2.4

Damages, Claims for
3.2.4, 3.18, 6.1.1, 8.3.3, 9.5.1, 9.6.7, 10.3.3, 11.3.2, 11.3, 14.2.4, 15.1.7

Damages for Delay
6.2.3, 8.3.3, 9.5.1.6, 9.7, 10.3.2, 14.3.2

Date of Commencement of the Work, Definition of
8.1.2

Date of Substantial Completion, Definition of
8.1.3

Day, Definition of
8.1.4

Decisions of the Architect
3.7.4, 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 6.3, 7.3.4, 7.3.9, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.4, 9.9.1, 13.4.2, 14.2.2, 14.2.4, 15.1, 15.2

Decisions to Withhold Certification
9.4.1, **9.5**, 9.7, 14.1.1.3

Defective or Nonconforming Work, Acceptance, Rejection and Correction of
2.5, 3.5, 4.2.6, 6.2.3, 9.5.1, 9.5.3, 9.6.6, 9.8.2, 9.9.3, 9.10.4, 12.2.1

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

Delays and Extensions of Time
3.2, **3.7.4**, 5.2.3, 7.2.1, 7.3.1, **7.4**, **8.3**, 9.5.1, **9.7**, 10.3.2, **10.4**, 14.3.2, **15.1.6**, 15.2.5

Digital Data Use and Transmission
1.7

Disputes
6.3, 7.3.9, 15.1, 15.2

Documents and Samples at the Site
3.11

Drawings, Definition of
1.1.5

Drawings and Specifications, Use and Ownership of
3.11

Effective Date of Insurance
8.2.2

Emergencies
10.4, 14.1.1.2, **15.1.5**

Employees, Contractor's
3.3.2, 3.4.3, 3.8.1, 3.9, 3.18.2, 4.2.3, 4.2.6, 10.2, 10.3.3, 11.3, 14.1, 14.2.1.1

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

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

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

Failure of Payment
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

Faulty Work
(See Defective or Nonconforming Work)

Final Completion and Final Payment
4.2.1, 4.2.9, 9.8.2, **9.10**, 12.3, 14.2.4, 14.4.3

Financial Arrangements, Owner's
2.2.1, 13.2.2, 14.1.1.4

GENERAL PROVISIONS

1

Governing Law

13.1

Guarantees (See Warranty)

Hazardous Materials and Substances

10.2.4, 10.3

Identification of Subcontractors and Suppliers

5.2.1

Indemnification

3.17, 3.18, 9.6.8, 9.10.2, 10.3.3, 11.3

Information and Services Required of the Owner

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

Initial Decision

15.2

Initial Decision Maker, Definition of

1.1.8

Initial Decision Maker, Decisions

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

Initial Decision Maker, Extent of Authority

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

Injury or Damage to Person or Property

10.2.8, 10.4

Inspections

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

Instructions to Bidders

1.1.1

Instructions to the Contractor

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

Instruments of Service, Definition of

1.1.7

Insurance

6.1.1, 7.3.4, 8.2.2, 9.3.2, 9.8.4, 9.9.1, 9.10.2, 10.2.5, 11

Insurance, Notice of Cancellation or Expiration

11.1.4, 11.2.3

Insurance, Contractor's Liability

11.1

Insurance, Effective Date of

8.2.2, 14.4.2

Insurance, Owner's Liability

11.2

Insurance, Property

10.2.5, 11.2, 11.4, 11.5

Insurance, Stored Materials

9.3.2

INSURANCE AND BONDS

11

Insurance Companies, Consent to Partial Occupancy

9.9.1

Insured loss, Adjustment and Settlement of

11.5

Intent of the Contract Documents

1.2.1, 4.2.7, 4.2.12, 4.2.13

Interest

13.5

Interpretation

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

Interpretations, Written

4.2.11, 4.2.12

Judgment on Final Award

15.4.2

Labor and Materials, Equipment

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

Labor Disputes

8.3.1

Laws and Regulations

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

Liens

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

Limitations, Statutes of

12.2.5, 15.1.2, 15.4.1.1

Limitations of Liability

3.2.2, 3.5, 3.12.10, 3.12.10.1, 3.17, 3.18.1, 4.2.6, 4.2.7, 6.2.2, 9.4.2, 9.6.4, 9.6.7, 9.6.8, 10.2.5, 10.3.3, 11.3, 12.2.5, 13.3.1

Limitations of Time

2.1.2, 2.2, 2.5, 3.2.2, 3.10, 3.11, 3.12.5, 3.15.1, 4.2.7, 5.2, 5.3, 5.4.1, 6.2.4, 7.3, 7.4, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.5, 9.6, 9.7, 9.8, 9.9, 9.10, 12.2, 13.4, 14, 15, 15.1.2, 15.1.3, 15.1.5

Materials, Hazardous

10.2.4, 10.3

Materials, Labor, Equipment and

1.1.3, 1.1.6, 3.4.1, 3.5, 3.8.2, 3.8.3, 3.12, 3.13, 3.15.1, 5.2.1, 6.2.1, 7.3.4, 9.3.2, 9.3.3, 9.5.1.3, 9.10.2, 10.2.1.2, 10.2.4, 14.2.1.1, 14.2.1.2

Means, Methods, Techniques, Sequences and Procedures of Construction

3.3.1, 3.12.10, 4.2.2, 4.2.7, 9.4.2

Mechanic's Lien

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

Mediation

8.3.1, 15.1.3.2, 15.2.1, 15.2.5, 15.2.6, 15.3, 15.4.1, 15.4.1.1

Minor Changes in the Work

1.1.1, 3.4.2, 3.12.8, 4.2.8, 7.1, 7.4

MISCELLANEOUS PROVISIONS

13

Modifications, Definition of

1.1.1

Modifications to the Contract

1.1.1, 1.1.2, 2.5, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7, 10.3.2

Mutual Responsibility

6.2

Nonconforming Work, Acceptance of

9.6.6, 9.9.3, 12.3

Nonconforming Work, Rejection and Correction of
2.4, 2.5, 3.5, 4.2.6, 6.2.4, 9.5.1, 9.8.2, 9.9.3, 9.10.4,
12.2

Notice

1.6, 1.6.1, 1.6.2, 2.1.2, 2.2.2., 2.2.3, 2.2.4, 2.5, 3.2.4,
3.3.1, 3.7.4, 3.7.5, 3.9.2, 3.12.9, 3.12.10, 5.2.1, 7.4,
8.2.2 9.6.8, 9.7, 9.10.1, 10.2.8, 10.3.2, 11.5, 12.2.2.1,
13.4.1, 13.4.2, 14.1, 14.2.2, 14.4.2, 15.1.3, 15.1.5,
15.1.6, 15.4.1

Notice of Cancellation or Expiration of Insurance
11.1.4, 11.2.3

Notice of Claims

1.6.2, 2.1.2, 3.7.4, 9.6.8, 10.2.8, **15.1.3**, 15.1.5, 15.1.6,
15.2.8, 15.3.2, 15.4.1

Notice of Testing and Inspections
13.4.1, 13.4.2

Observations, Contractor's
3.2, 3.7.4

Occupancy
2.3.1, 9.6.6, 9.8

Orders, Written
1.1.1, 2.4, 3.9.2, 7, 8.2.2, 11.5, 12.1, 12.2.2.1, 13.4.2,
14.3.1

OWNER 2

Owner, Definition of
2.1.1

Owner, Evidence of Financial Arrangements
2.2, 13.2.2, 14.1.1.4

Owner, Information and Services Required of the
2.1.2, **2.2**, 2.3, 3.2.2, 3.12.10, 6.1.3, 6.1.4, 6.2.5, 9.3.2,
9.6.1, 9.6.4, 9.9.2, 9.10.3, 10.3.3, 11.2, 13.4.1, 13.4.2,
14.1.1.4, 14.1.4, 15.1.4

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

Owner's Insurance
11.2

Owner's Relationship with Subcontractors
1.1.2, 5.2, 5.3, 5.4, 9.6.4, 9.10.2, 14.2.2

Owner's Right to Carry Out the Work
2.5, 14.2.2

Owner's Right to Clean Up
6.3

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

6.1
Owner's Right to Stop the Work
2.4

Owner's Right to Suspend the Work
14.3

Owner's Right to Terminate the Contract
14.2, 14.4

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

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

Partial Occupancy or Use
9.6.6, **9.9**

Patching, Cutting and
3.14, 6.2.5

Patents
3.17

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

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

Payment, Failure of
9.5.1.3, **9.7**, 9.10.2, 13.5, 14.1.1.3, 14.2.1.2

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

Payment Bond, Performance Bond and
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**

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

PAYMENTS AND COMPLETION 9

Payments to Subcontractors
5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 9.6.7, 14.2.1.2

PCB
10.3.1

Performance Bond and Payment Bond
7.3.4.4, 9.6.7, 9.10.3, **11.1.2**

Permits, Fees, Notices and Compliance with Laws
2.3.1, **3.7**, 3.13, 7.3.4.4, 10.2.2

PERSONS AND PROPERTY, PROTECTION OF 10

Polychlorinated Biphenyl
10.3.1

Product Data, Definition of
3.12.2

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

Progress and Completion
4.2.2, **8.2**, 9.8, 9.9.1, 14.1.4, 15.1.4

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

Project, Definition of
1.1.4

Project Representatives
4.2.10

Property Insurance
10.2.5, **11.2**

Proposal Requirements
1.1.1

PROTECTION OF PERSONS AND PROPERTY 10

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

Rejection of Work
4.2.6, 12.2.1

Releases and Waivers of Liens
9.3.1, 9.10.2

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

Representatives
2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.10, 13.2.1

Responsibility for Those Performing the Work
3.3.2, 3.18, 4.2.2, 4.2.3, 5.3, 6.1.3, 6.2, 6.3, 9.5.1, 10

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

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

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

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

Rights and Remedies
1.1.2, 2.4, 2.5, 3.5, 3.7.4, 3.15.2, 4.2.6, 5.3, 5.4, 6.1,
6.3, 7.3.1, 8.3, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.1, 12.2.2,
12.2.4, 13.3, 14, 15.4

Royalties, Patents and Copyrights
3.17

Rules and Notices for Arbitration
15.4.1

Safety of Persons and Property
10.2, 10.4

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

Samples, Definition of
3.12.3

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

Samples at the Site, Documents and
3.11

Schedule of Values
9.2, 9.3.1

Schedules, Construction
3.10, 3.12.1, 3.12.2, 6.1.3, 15.1.6.2

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

Separate Contractors, Definition of
6.1.1

Shop Drawings, Definition of
3.12.1

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

Site, Use of
3.13, 6.1.1, 6.2.1

Site Inspections
3.2.2, 3.3.3, 3.7.1, 3.7.4, 4.2, 9.9.2, 9.4.2, 9.10.1, 13.4

Site Visits, Architect's
3.7.4, 4.2.2, 4.2.9, 9.4.2, 9.5.1, 9.9.2, 9.10.1, 13.4

Special Inspections and Testing
4.2.6, 12.2.1, 13.4

Specifications, Definition of
1.1.6

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

Statute of Limitations
15.1.2, 15.4.1.1

Stopping the Work
2.2.2, 2.4, 9.7, 10.3, 14.1

Stored Materials
6.2.1, 9.3.2, 10.2.1.2, 10.2.4

Subcontractor, Definition of
5.1.1

SUBCONTRACTORS
5

Subcontractors, Work by
1.2.2, 3.3.2, 3.12.1, 3.18, 4.2.3, 5.2.3, 5.3, 5.4, 9.3.1.2,
9.6.7

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

Submittals
3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.4, 9.2, 9.3, 9.8,
9.9.1, 9.10.2, 9.10.3

Submittal Schedule
3.10.2, 3.12.5, 4.2.7

Subrogation, Waivers of
6.1.1, 11.3

Substances, Hazardous
10.3

Substantial Completion
4.2.9, 8.1.1, 8.1.3, 8.2.3, 9.4.2, 9.8, 9.9.1, 9.10.3, 12.2,
15.1.2

Substantial Completion, Definition of
9.8.1

Substitution of Subcontractors
5.2.3, 5.2.4

Substitution of Architect
2.3.3

Substitutions of Materials
3.4.2, 3.5, 7.3.8

Sub-subcontractor, Definition of
5.1.2

Subsurface Conditions
3.7.4

Successors and Assigns
13.2

Superintendent
3.9, 10.2.6

Supervision and Construction Procedures
1.2.2, 3.3, 3.4, 3.12.10, 4.2.2, 4.2.7, 6.1.3, 6.2.4, 7.1.3,
7.3.4, 8.2, 8.3.1, 9.4.2, 10, 12, 14, 15.1.4

Suppliers
1.5, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3, 9.4.2, 9.5.4, 9.6,
9.10.5, 14.2.1

Surety
5.4.1.2, 9.6.8, 9.8.5, 9.10.2, 9.10.3, 11.1.2, 14.2.2,
15.2.7
Surety, Consent of
9.8.5, 9.10.2, 9.10.3
Surveys
1.1.7, 2.3.4
Suspension by the Owner for Convenience
14.3
Suspension of the Work
3.7.5, 5.4.2, 14.3
Suspension or Termination of the Contract
5.4.1.1, 14
Taxes
3.6, 3.8.2.1, 7.3.4.4
Termination by the Contractor
14.1, 15.1.7
Termination by the Owner for Cause
5.4.1.1, **14.2, 15.1.7**
Termination by the Owner for Convenience
14.4
Termination of the Architect
2.3.3
Termination of the Contractor Employment
14.2.2

TERMINATION OR SUSPENSION OF THE CONTRACT

14

Tests and Inspections

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

TIME

8

Time, Delays and Extensions of

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

Time Limits

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

Time Limits on Claims

3.7.4, 10.2.8, 15.1.2, 15.1.3

Title to Work

9.3.2, 9.3.3

UNCOVERING AND CORRECTION OF WORK

12

Uncovering of Work

12.1

Unforeseen Conditions, Concealed or Unknown

3.7.4, 8.3.1, 10.3

Unit Prices

7.3.3.2, 9.1.2

Use of Documents

1.1.1, 1.5, 2.3.6, 3.12.6, 5.3

Use of Site

3.13, 6.1.1, 6.2.1

Values, Schedule of

9.2, 9.3.1

Waiver of Claims by the Architect

13.3.2

Waiver of Claims by the Contractor

9.10.5, 13.3.2, **15.1.7**

Waiver of Claims by the Owner

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

Waiver of Consequential Damages

14.2.4, 15.1.7

Waiver of Liens

9.3, 9.10.2, 9.10.4

Waivers of Subrogation

6.1.1, **11.3**

Warranty

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

Weather Delays

8.3, 15.1.6.2

Work, Definition of

1.1.3

Written Consent

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

Written Interpretations

4.2.11, 4.2.12

Written Orders

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

ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

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

§ 1.1.2 The Contract

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

§ 1.1.3 The Work

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

§ 1.1.4 The Project

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

§ 1.1.5 The Drawings

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

§ 1.1.6 The Specifications

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

§ 1.1.7 Instruments of Service

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

§ 1.1.8 Initial Decision Maker

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

§ 1.2 Correlation and Intent of the Contract Documents

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

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon 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.

ADDENDUM to A201-2017 – General Conditions of the Contract for Construction

SUPPLEMENTARY CONDITIONS

Section 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 Architect.

Section 3.6.1 .1 There will be a Certificate Expiration Date on the Missouri Project Exemption Certificates which will correspond with the Estimated Project Completion Date. If this ~~date~~ **date** should have to be extended, the Contractor shall contact the Architect and the School District for a revised expiration date.

Section 3.7.2 The Contractor shall comply and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, **district board policies**, and lawful orders of public authorities applicable to performance of the Work. If the Contractor performs any Work in a manner contrary to such laws, ordinances, rules and regulations, and without such notice to Architect, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

Section 11.3.1.4 This should become Section 11.1.5.

Section 11.3.1.6 This should become Section 11.2.4

Section 11.3.7 This language is now included in A201-2017, Section 11.3.1.

Section 11.4.1 This language could be added to the end of 11.1.2.

Section 14.1.1.4 Delete Sections 14.1.1.4 and 14.1.1.5

Section 14.1.2.3 The language of A201-2017 stating “on three (3) or more occasions” is acceptable

Section 15.1.2 This language is now included in A201-2017, Section 15.1.3.1.

Section 15.1.4 This language is now provided in Section 15.1.5 of A201-2017

Section 15.2.1 This language has been significantly modified and the mediation section (15.3) has been added. Section 15.3 is generally acceptable.

SPECIAL CONDITIONS

Section 1.12 The prevailing wage law has been modified to exclude contracts under \$75,000. This is simply being noted in the event that a contract would fail to exceed that amount, prevailing wage would not be required.

[New] Section 1.17 Before employment of any employee, contractor, subcontractor, consultant, or subconsultant who is an individual for work on this Project, the Contractor shall conduct or shall

allow the Owner to conduct background checks through all appropriate state agencies and any other background checks as may be standard for entities providing services to public schools, including without limitation, a thorough review of the list of registered sex offenders as provided by the County Sheriff's Department, and any such individual who does not pass such background check as determined by the Owner in its sole discretion shall not be permitted to enter the premises where the Project is located or any other school district property or to work on the Project. The Contractor shall include all of these requirements in its contracts with its subcontractors and suppliers.

A101-2017 EXHIBIT A

A.2.1 General Add this statement to the end of the section: **Owner preserves all immunities recognized at law. Nothing herein shall be construed as a waiver of Sovereign Immunity or Governmental Immunity by whatever name as set forth in Mo. Rev. Stat. § 537.600 et seq. Any insurance purchased by Owner or Contractor hereto is not intended to act as a waiver, nor is it a waiver of any defense available to Owner and its employees by statute or at common law. No insurance purchased by Owner herein is not intended to cover machinery, tools, and equipment owned or rented by the Contractor that are utilized in the performance of the Work but not incorporated into the permanent improvements.**

A.2.4 Optional Extended Property Insurance – this section A.2.4.1 – A.2.4.7 is subject to review and negotiation, based upon the District's preferences.

A.2.5 Other Optional Insurance – same as A.2.4 above (negotiable).

A.3.1.1. Add this language to the end of section A.3.1.1: **The Contractor shall furnish the Owner with a satisfactory proof of carriage of the insurance required. Certificates of insurance will be required in duplicate for file with the Owner and with the A/E, such certificates to provide that the Owner is entitled to the same notice as that given to the purchaser of the insurance in case of cancellation or any major change therein. Owner preserves all immunities recognized at law. Nothing herein shall be construed as a waiver of Sovereign Immunity or Governmental Immunity by whatever name as set forth in Mo. Rev. Stat. § 537.600 et seq. Any insurance purchased by Owner or Contractor hereto is not intended to act as a waiver, nor is it a waiver of any defense available to Owner and its employees by statute or at common law.**

A.3.2.2 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 State of Missouri and that carries a Best policyholder's rating of "A" or better; and carrier at least Class X financial rating.** 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:

A.3.2.2.1 CGL Limits

General CGL: \$1,000,000 per Occurrence
 \$1,000,000 General Aggregate

Aggregate for Products-Completed operations hazard: Contact MUSIC for recommendation

Automobile: \$1,000,000 per accident (Combined Single Limit Bodily Injury and Property Damage)

Excess Liability: \$2,000,000 (Umbrella)

A.3.2.2.5 Workers' Comp: Contractor shall take out, pay for and maintain at all times during the prosecution of the work under the contract, the following forms of insurance, by carriers acceptable to and approved by Owner.

Statutory Workmen's Compensation and Employer's Liability Insurance: The Contractor shall procure and shall maintain during the life of this Contract, Statutory Compensation Insurance and Employer's Liability Insurance with limits as shown below for all of his employees to be engaged in work for the project under this Contract. In case of any such work sublet, the Contractor shall similarly require Subcontractors to provide Statutory Workmen's Compensation Insurance and Employer's Liability Insurance for all of the latter's employees to be engaged in such work unless such employees are covered by the protection afforded by the Contractor's Workmen's Compensation Insurance. In case any class of employees engaged in hazardous work on the project under this Contract is not protected under the Workmen's Compensation Statute, the Contractor shall provide, and shall cause such Subcontractor to provide, adequate Employer's Liability Insurance for the protection of such of the employees as are not otherwise protected.

Workers' Compensation and Employers' Liability (Per Contract)

Each Accident \$500,000

Disease - Policy Limit \$500,000

Disease - Each Employee \$500,000

A.3.4 Performance Bonds and Payment Bond

Type	Penal Sum (\$)
Payment Bond	Set value
Performance Bond	Set value

DOCUMENT 007300 - SUPPLEMENTARY CONDITIONS

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

ARTICLE 1 – GENERAL PROVISIONS

Add to the end of Subparagraph 1.1.2:

The Contract Form will be the Standard Form of Agreement Between Owner and Contractor (Stipulated Sum), AIA Document A101, [and attached Addendum](#).

Add to the end of Subparagraph 1.1.3:

1.1.3 The work referred to in these documents consists of the furnishing of all labor, materials and equipment for the complete installation of all work specified herein and shown on the drawings, including; hauling off, delivery, unloading, uncrating, assembly, setting-in-place, leveling, completely installed and clean up of any debris.

Add the following definitions:

1.1.9 Product: Materials, systems and equipment incorporated or to be incorporated in the Work.

1.1.10 Provide: Furnish and install and shall include, without limitation, labor, materials, equipment, transportation, services and other items required to complete the referenced tasks.

1.1.11 Furnish: Pay for, deliver (or receive), unload, uncrate, inspect and store as specified or directed while retaining care, custody and control until received for installation by others based on a signed receipt.

1.1.12 Install: Receive, unload, uncrate, inspect and store as specified or directed while retaining care, custody, and control; set or place in position, make required connections, adjust and test for satisfactory performance and operation.

1.1.13 Not In Contract (N.I.C.): Products not in Contract, but which may require provisions in the Work for future installation.

1.1.14 By Owner Future (B.O.F.): Items furnished and installed by Owner and are not in the Contract but may require rough-in services, blocking and anchorage devices, for future installation.

1.1.15 By Owner (B.O.): Items ordered, paid for and shipped to Project by Owner. Contractor shall receive, unload, unpack or uncrate, protect, move into place, install and connect items.

1.1.16 Relocate Existing (R.E.): Existing items requiring relocation under the Contract and which may require service disconnection and capping and new service connections.

Add Clause 1.2.2.1:

1.2.2.1 The terms "Contractor", "furnished under other sections", "included as part of other sections", "related work in other sections", or similar description of segregation shall not be interpreted to limit the responsibility of any particular party involved in the Work. The limitations of any subcontractor's work shall rest solely upon the agreement between the General Contractor and the Subcontractor, regardless of where the work is called for in the Contract Documents.

Add Clauses 1.2.3.1 and 1.2.3.2:

1.2.3.1 When, in the Specifications, a word such as "approved comparable product", "approved substitute", "satisfactory", "as directed", etc., is used, it implies such reference is to the Architect's specific approval and directions. Whenever substitutions; products, materials and equipment not originally specified, alter the design or space requirements indicated in the Contract Documents, the Contractor shall include all items of cost of the revised design and construction, including costs of all allied trades involved.

1.2.3.1 Whenever the words "necessary", "proper", or words of like effect are used in the Contract Documents with respect to the extent, conduct, or character of work specified, they shall mean that the said work shall be carried to the extent, must be conducted in a manner, or be of a character which is "necessary" or "proper" under the circumstances in the opinion of the Architect, and the Architect's judgment in such matters shall be considered final.

Add Subparagraphs 1.2.4 through 1.2.6:

1.2.4 In case of actual and alleged conflicts and inconsistencies between Drawings and Specifications, Schedules, or other Contract Documents, or within any Document not clarified by addendum; the better quality and greater quantity of Work consistent with the design indicated, shall be deemed to be the basis of the Contractor's Bid and the Contract Sum. Failure to report alleged conflicts and inconsistencies in the Contract Documents shall be deemed as evidence that the Contractor has elected to proceed in the more expensive manner, as the basis of the Contract Sum. Work involving any alleged conflict or inconsistency shall be provided in accordance with the Architect's interpretation.

1.2.5 Where items are specified by use of reference standard specifications or to codes of local or state authorities, the date of the reference shall be the latest edition published as of the date of the Agreement, unless a specific edition is referenced in the Specifications or in an applicable code, in which case the code reference to the specific edition shall govern.

1.2.6 Materials which are shown on the Drawings and which may not be specifically described in the Specifications or on the Drawings, shall be compatible with adjacent materials, and shall be subject to review and acceptance by the architect for conformance with the intent of the Contract Documents. Where installation techniques are not specified, installation shall be in accordance with the manufacturer's current instructions and industry standards, as acceptable to the Architect.

ARTICLE 2 - OWNER

Revise Paragraph 2.5. as follows:

In the first sentence, DELETE "a ten-day period" and INSERT in it's place, "forty-eight hours". In the second sentence, DELETE the word "reasonable".

ARTICLE 3 - CONTRACTOR

Add clause 3.2.2.1:

3.2.2.1 The Contractor shall notify the Architect of actual or alleged conflicts and inconsistencies between Drawings and Specifications, Schedules, or other Contract Documents, or within any Document not clarified by addendum in accordance with Subparagraph 1.2.4 of these Supplementary Conditions.

Add Subparagraph 3.2.5:

3.2.5 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for evaluating and responding to the Contractor's requests for information that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

Add Clause 3.4.2.1:

3.4.2.1 After the Contract has been executed, the Owner and Architect will consider requests for substitution of products in place of those specified only under the conditions set forth in the General Requirements (Division 1 of the Specifications). Substitutions for Convenience and Substitutions fo Cause shall be made in accordance with Article 7 and as set forth in Sections 012500 and 016000.

- .1 After execution of the Contract, substitutions **for "Cause"** for specified materials constitute "changes in the work" and may be proposed by the Contractor up to thirty (30) days after date of Award of the Contract only on condition that either:
 - .a Specified item has been discontinued or is unavailable in time frame to meet the Project schedule due to conditions beyond the control of the Contractor, or
 - .b Specified item has been determined to be unsuitable for the Project, or
 - .c Owner will benefit by a reduced cost or an improved Project. Owner is to receive full benefit of any cost reductions.
- .2 Requests for substitutions shall comply with requirements specified in Sections 012500 and 016000, in addition to including the following:
 - .a Statement of cause for request with substantiating documents.
 - .b Documentary proof of equal or superior quality, delivery time, and costs in the form of certified

quotations from suppliers of both specified and proposed items. Approved substitutions will be incorporated into the Work by Change Order or Construction Change Directive under provisions of Article 7.

Add Clause 3.4.2.2:

3.4.2.2 The Owner shall be entitled to reimbursement from the Contractor for amounts paid to the Architect for reviewing the Contractor's proposed substitutions and to make agreed-upon changes in the Drawings and Specifications made necessary by the Owner's acceptance of such substitutions.

Add Subparagraph 3.6.1:

3.6.1 The Owner is sales tax-exempt under State of Missouri Statutes. A Missouri Project Exemption Certificate approved by the Missouri Department of Revenue and a copy of the Owner's current 'Missouri Tax Exemption Letter' will be furnished to the Contractor as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated or consumed in the construction of the Project on a sales tax-exempt basis. The Contractor shall furnish copies of the Exemption Certificate and Missouri Tax Exemption Letter to its Subcontractors and Suppliers on this Project.

- .1 Procedure for obtaining those exemption certificates - Contractor shall submit a complete list of Subcontractor's who will be working on the project along with their addresses, phone numbers and contact persons to Travis Hux or Josh Hustad of the Raytown Quality Schools. The Owner will type all information on the Missouri Project Exemption Certificates and mail back to the Contractor. The Contractor shall keep a copy of each of these certificates in his file and mail a set to each of his Subcontractors.
- .2 There will be a Certificate Expiration Date on the Missouri Project Exemption Certificates which will correspond with the Estimated Project Completion Date. If this data should have to be extended, the Contractor shall contact the Architect and the School District for a revised expiration date. A revised Missouri Project Exemption Certificate will be issued to you reflecting the revised expiration date. The Contractor shall submit, to the Owner, a list of all Subcontractors still working on the project at that time who will need the revised Missouri Project Exemption Certificate.
- .3 A copy of these certificates will be on file with the Owner.

Add Clause 3.10.1.1:

A detailed time line schedule shall be submitted within fifteen (15) days after Award of the Contract. In addition to detailed information required in Subparagraph 3.10.1, the Contractor's Construction Schedule shall include anticipated labor/crew size, manpower, activity durations. Schedule information shall include shop drawing submittal schedule, material delivery schedule and construction activity information. Submit update of schedule with each request for payment. Pay requests will not be processed without being accompanied with an updated construction and submittal schedules.

Add Subparagraph 3.10.4:

3.10.4 The Contractor, Subcontractors, sub-subcontractors and suppliers shall furnish sufficient forces, construction plant and equipment, and shall work such hours as may be necessary to ensure the timely execution of the Work in accordance with the time limits set forth in the Contract Documents. If, in the opinion of the Owner, the Contractor falls behind the time constraints indicated in the Construction Progress Schedule, the Contractor shall take such steps as may be necessary to improve the progress of the Work. The Owner may require the Contractor to increase the number of shifts, and/or overtime operations and days of the work including holidays, Saturdays and Sundays, all without additional cost to the Owner.

Add Clause 3.12.6.1:

3.12.6.1 The Architect's review of Contractor's submittals will be limited to examination of an initial submittal and one (1) resubmittal. The Architect's review of additional submittals will be made only with the consent of the Owner after notification by the Architect. The Owner is entitled to obtain reimbursement from the Contractor for amounts paid to the Architect for evaluation of additional resubmittals.

ARTICLE 4 - ARCHITECT

Add Clause 4.2.2.1:

4.2.2.1 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for site visits made necessary by the fault of the Contractor or by defects and deficiencies in the Work.

ARTICLE 5 - SUBCONTRACTORS

Revise Subparagraph 5.2.1 as follows:

In the first sentence delete “as soon as practicable” and insert “no later than seven days”.

Add Clause 5.2.1.1:

5.2.1.1 Notice of no reasonable objection shall in no way be construed or indicate prior acceptance or approval of materials or equipment for which persons or entities may be agents or representatives, and shall not relieve the Contractor from full and complete responsibility for the quality of the Work and performance of those with whom the Contractor executes a contract.

Add Subparagraph 5.3.1:

5.3.1 The Contractor shall require each subcontractor to designate one individual as the on-site foreman/supervisor of the Subcontractor’s work, who shall direct the Work at all times the Subcontractor is performing work and who shall confer with the Contractor before reducing his/her work forces or leaving the project unsupervised. The foreman/supervisor shall act for the Subcontractor in all areas as designated by the Subcontract.

ARTICLE 7 - CHANGES IN THE WORK

Modify Subparagraph 7.3.8:

Pending final determination of cost to the Owner, amounts not in dispute may be included in Applications for Payment. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect including an allowance for overhead and profit.

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 or decrease, if any, with respect to that change.

Add Subparagraph 7.3.11

7.3.11 In Subparagraph 7.3.7, the allowance for the combined overhead and profit included in the total cost to the Owner for increase and decrease change orders shall be based on the following:

7.3.11.1 The allowances to the Contractor for Work performed by the Contractor with the Contractor's own forces and for materials purchased directly by the Contractor (not through a Subcontractor).

7.3.11.2 The allowances to the Contractor and Subcontractor for Work performed by the Subcontractor with that Subcontractor's own forces or purchased directly by that Subcontractor (not through a Sub-subcontractor).

7.3.11.3 Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.7.

7.3.11.4 In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials, and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also. In no case will a change be approved without such itemization, except those so minor that the change can be seen by inspection.

ARTICLE 9 - PAYMENTS AND COMPLETION

Add Clause 9.3.1.3:

9.3.1.3 The Contractor shall submit three (3) of each of the following: Notarized applications for payment; previous month’s affidavits and partial liens waivers from Contractor, Subcontractors and suppliers, and supporting documents. Non-Negotiable Bailment Receipt form and Partial Lien Release form are included at the end of this Section for use.

Add to Subparagraph 9.4.1:

Five percent (5%) of the Sum of each Application for Payment shall be retained until the Project is Substantially Complete. Thereafter, no further retainage will be withheld provided, however, that Satisfactory Progress and Performance is being made in the Work. Final Payment shall be in accord with Article 9, and shall be made within thirty (30) days after issue of the final Certificate of Payment. The retained percentage shall be withheld until final payment.

Add to Subparagraph 9.6.1:

The Architect may decline to approve any Application for Payment and the Owner shall not be required to make any Progress

Payments or Final Payment to the Contractor if the Contractor is in violation of any term or condition of this Agreement, the General Conditions of the Contract (AIA Document A201), or the Supplementary Conditions, or if the Contractor fails to timely provide any information reasonably requested by Owner.

Add to Subparagraph 9.8.3:

The Contractor and each Subcontractor shall carefully and regularly check their work for conformance as the work is being done. Unsatisfactory work shall be corrected as the work progresses and not be permitted to remain and become a part of the Punch List. When the Contractor determines that the entire work is ready for the Punch List inspection, he shall so notify the Architect/Engineer, who shall make arrangements for his Punch List inspection at the earliest possible date. Transmittal of the Punch List to the Contractor shall set the date for a Reinspection prior to issuance of a Certificate of Substantial Completion. Upon receipt of the Punch List, the Contractor shall within seven (7) days bring to the attention of the Architect/Engineer any questions that he or any of his Subcontractors may have concerning the requirements of the Punch List. When advised by the Contractor that all items on the Punch List have been completed and/or corrected, the Architect/Engineer shall make a Reinspection and shall be accompanied by the Contractor, any needed Subcontractors (and the Owner's representative where applicable) to determine whether the Certificate of Substantial Completion can be issued. When issued, the Certificate of Substantial Completion shall name the date, triggering the beginning of the Warranty period (with any items to have a later starting date specifically noted). The Certificate of Substantial Completion shall also have attached to it the uncompleted Punch List items, and shall name the date for their completion. The Certificate of Substantial Completion shall also state the responsibilities of the Owner and the Contractor for maintenance, heat, utilities, insurance, and building security. Acknowledgment of the Date of Substantial Completion by the signature of all parties on the Certificate implies possession of the premises by the Owner, and completion of incomplete Punch List items by the Contractor and the Subcontractors at the Owner's convenience. The Owner shall cooperate in permitting the Contractor access to the work for the completion of Punch List items.

Add Clause 9.8.3.1:

9.8.3.1 Except with the consent of the Owner, the Architect will perform no more than two (2) inspections to determine whether the Work or a designated portion thereof has attained Substantial Completion in accordance with the Contract Documents. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for any additional inspections.

Add Clause 9.10.1.1:

9.10.1.1 Except with the consent of the Owner, the Architect will perform no more than two (2) inspections to determine whether the Work or a designated portion thereof has attained Final Completion in accordance with the Contract Documents. The Owner shall be entitled to deduct from the Contract Sum amounts paid to the Architect for any additional inspections.

Add Clauses 9.10.4.5 and 9.10.4.6:

9.10.4.5 Faulty or defective Work appearing after Final Payment is made; or

9.10.4.6 Direct damages sustained or asserted either as a result of any wrongful act or neglect of the Contractor, or as a result of any breach of Contract.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

Add Clause 10.3.1.1:

10.3.1.1 The Work shall be asbestos free. The Contractor shall, if requested, provide certification which attests to same. Reference in the technical specifications to Manufacturers, model numbers, equipment, material, article or process shall be regarded as establishing a standard of quality and/or function. The Contractor shall submit a request for substitution on any item which can not be certified to be asbestos free.

ARTICLE 11 – INSURANCE AND BONDS

Add to end of Subparagraph 11.1.1:

11.1.1 In the second sentence, after the word “from”, add the following: “...an insurance carrier licensed to do business in the state of Missouri; carries a Best’s policyholder rating of “A” or better; and carrier at least a Class X financial rating. The Contractor shall either cover all Subcontractors or require each Subcontractor not so covered to secure insurance in the minimum amounts required of the Contractor.”

ARTICLE 12 - UNCOVERING AND CORRECTION OF THE WORK

Add the following Clause 12.2.2.4:

12.2.2.4 Upon request of the Owner and prior to the expiration of one (1) year from the date of Substantial Completion, the Architect will conduct and the Contractor shall attend a meeting with the Owner to review the facility operations and performance.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

Add Subparagraph 13.1.1:

13.1.1 Environmental Performance: In order to secure approval to proceed with construction, the Owner is committed to comply with the Environmental Protection Agency rule under Section 203 of Title II of the Toxic Substance Control Act (TSCA), 15 U.S.C. 2643 which requires all local educational agencies to identify asbestos containing materials in their school building. The Contractor shall certify that all materials furnished and installed in this project are asbestos free in conformance to the Environmental Protection Agency requirements.

ARTICLE 15 - CLAIMS AND DISPUTES

Add Subclause 15.1.6.1.1 to read as follows:

15.1.6.1.1 Each month, Contractor shall notify the Architect of all claims for extensions of time, stating dates and causes for the time extensions. Notice shall accompany the Application for Payment; otherwise, they shall be waived. In the case of continuing cause of delay, only one claim is necessary.

Add Clauses 15.1.6.5 and 15.1.6.6:

15.1.6.5 Claims for increase in the Contract Time shall set forth in detail the circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work, the date upon which each cause of delay ceased to affect the progress of the Work and the number of days’ increase in the Contract Time claimed as a consequence of each such cause of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis for the Claim.

15.1.6.6 The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor.

Revise Subparagraph 15.2.1 as follows:

In the third sentence line delete “mediation” and insert “litigation”.

Revise Subparagraph 15.2.5 as follows:

In the third sentence delete “mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution” and insert “litigation”.

Revise Subparagraph 15.2.6 as follows:

Delete the word “mediation” and insert “litigation”.

Revise Clause 15.2.6.1 as follows:

In the first and second sentences, delete the word “mediation” and insert “litigation”. In the second sentence, delete the word “mediate” and insert “litigate”.

Add new Clause 15.2.6.2:

15.2.6.2 Any disputes between the Owner and the Contractor shall be tried before the District Court of Jackson County Missouri, unless the parties mutually agree otherwise.

DELETE Paragraph 15.3, MEDIATION, in its entirety, including Subparagraphs and Clauses 15.3.1 through 15.3.3.

DELETE Paragraph 15.4 - ARBITRATION, in its entirety, including Subparagraphs and Clauses 15.4.1 through 15.4.4.3.

END OF SUPPLEMENTARY CONDITIONS

SECTION 007400 - SPECIAL CONDITIONS

- 1.1 GENERAL: The Division of the body of these Specifications into various Sections is done for clarity in the explanation of the individual parts of the whole work. It is not the intent of such division to develop any secondary responsibilities for the satisfactory completion of the work as required by the Drawings and Specifications. Along those same lines, assignment by the Architect of parts of work to any trade or craft is not to be inferred from these Documents.
- 1.2 CODES, LAWS, STANDARDS, and PERMITS
- A. Contractor's performance, workmanship and material shall comply with all governing codes, state statutes and regulations, city ordinances and regulations of regulatory bodies having jurisdiction.
 - B. The Contractor shall comply with rules and regulations of public utilities and municipal departments affected by work under this contract.
 - C. Laws, codes, ordinances and regulations shall take precedence, excepting only where work called for by the Drawings and Specifications exceeds code requirements in quality and/or quantity.
 - D. It will be the responsibility of the Owner to pay, apply and obtain the General Building permit. For ALL other permits required to complete the work by additional trades it will be the responsibility of the contractor and or subcontractor to obtain and pay for any such permits.
 - E. ALL Contractors working on this project are required to have a current Business License in Raytown, MO. It will be the responsibility of the General Contractor to advise all subcontractors of this requirement as well as providing a List of All Contractors working on the project to the Business License Compliance Offer at the City of Raytown, MO.
- 1.3 QUALIFICATIONS OF CONTRACTORS: All Contractors shall be a qualified with histories of successful performance acceptable to the Owner / Architect.
- A. Labor and Workmanship: All labor for the installation of material and equipment furnished under this Contract shall be done by experienced mechanics of the proper trade. All workmanship shall be first class and in compliance with the specific requirements of Drawings and Specifications.
 - B. All contractors bidding on construction contracts which exceed \$500,000.00 with the Raytown Quality School District shall meet qualification standards prior to acceptance of any bid.
 - C. The District shall investigate and examine the qualifications of all concerns and, upon determining that a contractor meets the requirements of this policy and is in all respects responsible, qualified and competent for the class, character and magnitude of the work which the applicant proposes or intends to perform under this proposed contract shall then be determined to be qualified to be awarded a bid.
 - D. In determining the acceptability of a contractor for the purpose of qualification, the District shall investigate and consider at least the following:
 - 1. Financial responsibility.
 - 2. The character, quality and availability of the contractor's equipment.
 - 3. The performance record of the contractor in the performance of other contracts for public or private improvements.
 - 4. The nature and extent of other contract commitments involving the use of contractor's machinery, equipment and personnel.
 - 5. The reputation for reliability and integrity.
 - 6. History of compliance with applicable State and Federal laws.
 - 7. Compliance with MBE/WBE Policies.
 - 8. The source of any labor involved in the project.

9. Any other fact which would materially affect the ability of the applicant to properly, adequately, expeditiously and satisfactorily perform such work as might be awarded to such contractor.
- E. Under no circumstance shall a contractor be qualified who fails to provide or participate in any of the aforementioned programs.
- 1.4 QUALIFICATIONS OF MANUFACTURER: Products used in the work of this specification shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect/Engineer.
- 1.5 CONTRACTS: When entering into any contract which exceeds \$500,000.00 involving labor or hiring any labor for public contract work, preference may be given to contractors, mechanics, artisans or other laborers of any class, who shall have actually resided in Jackson County, Missouri, for a period of six months preceding the start of their engagement.
- A. A contract or purchase may be awarded to a bidder utilizing local labor where the bid by such bidders is, in all material respects, comparable to the lowest responsible bid not utilizing local labor if the amount bid (labor, materials, and other services) by such bidder does not exceed the lowest bid not utilizing local labor by more than the following percentages, unless such an award is contrary to State or Federal law or regulations or unless the District, at its discretion, determines prior to giving notice soliciting bids that the provisions of this section shall not apply to the contract or purchases.
1. \$0 to \$500,000.00 – No preference
 2. \$500,000.00 to \$1,000,000.00 – 5 percent on the first \$500,000 and no adjustment for the amount between \$500,000.00 and \$1,000,000.00
 3. \$1,000,000.00 and Greater – 5 percent higher on the first \$500,000.00 and 2.5 percent on amount between \$500,000.00 and \$1,000,000.00
 4. No additional adjustment for amounts in excess of \$1,000,000.00
- B. The amount of any preference awarded will be based on the maximum preference awarded for size of the contract multiplied by the percentage of local labor compared to the total labor for the work.
- 1.6 CONSTRUCTION DOCUMENTS: Prior to the start of construction, if requested, the Contractor will be provided up to a maximum of five (5) sets of contract documents, specifications and drawings for use during the construction phase.
- 1.7 CONTRACTOR'S MATERIALS: All materials delivered to the Job Site shall be stored so as to be kept in First Class condition. Materials and equipment to be left on the job overnight shall be stored in a secure, weatherproof manner.
- 1.8 UTILITIES: Access to electrical and water utilities shall be provided by the Owner in reasonable quantities at no cost to the Contractor. The contractor shall be responsible for ALL extensions, modifications and applicable fees for these utilities to adapt them to his use.
- 1.9 EXAMINATION OF EXISTING CONDITIONS: It is recommended that bidders visit the project sites prior to Bid Date and become familiar with all existing conditions as they apply to their area of work. Failure to do so will in no way relieve the successful bidder from being required to complete all work in compliance with these Documents.
- 1.10 CONTRACTOR'S SUBMITTALS: Approval of required submittals must be obtained from the Architect prior to starting any work requiring submittals as specified. The Architect will return the submittals approved or disapproved within five (5) work days after receipt. Warranties are required at the completion of the contract work and no later than thirty (30) days after final inspection. One electronic and one paper copy of all warranties shall be provided unless otherwise specified.
- A. If an item has not received a positive review by the second submittal, any subsequent reviews by the Architect will be paid for by the Contractor at the rate of one-hundred dollars (\$110.00) per man-hour for review time until final approval is granted.

1.11 EXISTING BUILDING ACCESS

- A. All access through the existing buildings shall be coordinated with the Owner. The Contractor shall protect the interior floors, walls and ceilings from damage caused by such access.
- B. All finished surfaces of the existing building are assumed to be in good condition. It will be the responsibility of the Contractor to repair any damage caused during the course of the project and at no additional expense to the Owner. The Contractor shall, at his own option, inspect those areas affected by the new work, documenting any existing damage, and report same to the Owner / Architect at the Pre-Construction meeting.

1.12 PREVAILING WAGES: This is a Prevailing Wage project. Prevailing Wage information, including the applicable Wage Rates are included in another portion of these Documents for the Contractors review and use. The Contractor shall follow and enforce all requirements of the Prevailing Wage Law. Refer to Section 008100 "Prevailing Wage Determination" for additional requirements.

1.13 CLEANING AND ADJUSTMENT: Dirt and refuse resulting from the performance of the work shall be removed from the premises as required. Upon completion of the installation, visually inspect each installed item, thoroughly clean all surfaces by using the cleaning material recommended by the manufacturer of the finish being cleaned, and carefully adjust all operating components for optimum operation. All debris shall be kept to a minimum and at no time shall create a hazard to the occupants of the other buildings.

- A. In addition to clean-up provisions of the Specifications, Contractor shall take appropriate steps to prevent airborne dust due to work under this Contract. Water shall be applied wherever practical to settle and hold dust to a minimum, particularly during demolition and moving of materials.

1.14 RECORD DRAWING INFORMATION: Contractor shall designate one set of drawings and specifications as "*RECORD DRAWING INFORMATION DOCUMENTS*". Any changes are to be documented on these drawings and specifications. These documents shall be submitted to the Architect as part of the Close-out Documentation.

1.15 EMPLOYMENT VERIFICATION SYSTEM: Prior to commencement of the Work, Contractor shall provide to Owner a sworn affidavit and other sufficient documentation to affirm its enrollment and participation in the federal work authorization program. Federal work authorization program means the E-Verify Program maintained and operated by the United States Department of Homeland Security and the Social Security Administration, or any successor program. Contractor shall also provide Owner a sworn affidavit affirming that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services.

END OF SECTION 007400

SECTION 008100 – PREVAILING WAGE DETERMINATION

PART 1 - GENERAL

- 1.1 This Project is contracted under the requirements of Missouri Prevailing Wage Law. This Section includes general information and forms for convenience. Detailed requirements, information, forms, and assistance may be obtained by contacting the following:
1. Missouri Department of Labor and Industrial Relations
Division of Labor Standards
Prevailing Wage Section
PO Box 449
Jefferson City, MO 65102-0449
Phone: 573.751.3403
Fax: 573.751.3721
Email: prevailingwage@labor.mo.gov
Website: www.labor.mo.gov/lis/prevailingwage
 2. **Contractor shall be responsible for obtaining the latest information and rates regarding the Missouri Prevailing Wage Law, including but not limited to incremental increases, issued on or before the date of bids.**
- B. Prevailing Hourly Rate of Wages: Not less than the prevailing hourly rate of wages, as set out in the wage order attached, must be paid to all workers performing work under this Contract.
1. Contractor shall forfeit a penalty to the contracting public body of \$100 per day (or portion of a day) for each worker that is paid less than the prevailing rate for any work done under this Contract by the Contractor or by any Subcontractor.
 2. Submit certified copies of Contractor's and subcontractor's payrolls to contracting public body on a weekly basis.
- C. Safety Training Program: All on-site employees, including those of Contractor and subcontractors, are required to complete the ten-hour safety training program required under Section 292.675 RSMo, if they have not previously completed the program and have documentation of having done so.
1. Contractor shall forfeit a penalty to the contracting public body of \$2500 plus an additional \$100 for each employee, including those of subcontractors, for each calendar day, or portion thereof, such employee is employed without the required training.
- D. Construction Transient Employers: Every transient employer, as defined in section 285.230 RSMo, must post in a prominent and easily accessible place at the site, a clearly legible copy of the notices listed below. Any transient employer failing to comply with these requirements shall, under section 285.234 RSMo, be liable for a penalty of \$500 per day until notices are posted as required by the statute:
1. The notice of registration for employer withholding issued to such transient employer by the director of revenue.
 2. Proof of coverage for workers' compensation insurance or self-insurance signed by transient employer and verified by the Department of Revenue through records of the Division of Workers' Compensation.
 3. The notice of registration for unemployment insurance to such transient employer by the Division of Employment Security.
- E. Posting of Wage Rates: While work under this Contract is being performed, a legible list of all prevailing wage rates must remain posted in a prominent and easily accessible location at the site by the Contractor and each subcontractor on the project. Such notice shall remain posted during the full time that any worker is employed on the project.
- F. Project Notification - Contractor Information Notification: Before performing any Work, submit a completed PW-2 Form "Prevailing Wage Project Notification - Contractor Information Notification," available at www.labor.mo.gov/lis/prevailingwage under "Forms," to The Division of Labor Standards (DLS).
- G. Project Completion Notification – Affidavit of Compliance: Before final payment will be made, the Contractor shall file a fully executed affidavit, PW-4 Form "Affidavit – Compliance with the Prevailing Wage Law", available at www.labor.mo.gov/lis/prevailingwage under "Forms," to The Division of Labor Standards (DLS).

- H. Monthly Applications for Payment: Pursuant to prevailing wage laws, an Affidavit of Compliance (Form PW-4) must be filed with the District before payment will be approved. The District will withhold and retain any amounts due as a result of any violation of the prevailing wage law prior to making payment with any contractor. Include Affidavit of Compliance with each application for payment.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 008100

Missouri

Division of Labor Standards

WAGE AND HOUR SECTION



ERIC R. GREITENS, Governor

Annual Wage Order No. 25

Section 048

JACKSON COUNTY

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by

Matt Cowell, Director
Division of Labor Standards

Filed With Secretary of State: _____ **March 9, 2018**

Last Date Objections May Be Filed: **April 9, 2018**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	** Date of Increase	*	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits
Asbestos Worker (H & F) Insulator			\$38.12	52	53	\$25.75
Boilermaker	6/18		\$37.91	57	7	\$29.38
Bricklayer and Stone Mason	6/18		\$35.43	58	39	\$19.73
Carpenter	6/18		\$38.85	63	68	\$17.10
Cement Mason	6/18		\$31.71	65	4	\$19.67
Communication Technician	6/18		\$35.55	47	72	\$21.73
Electrician (Inside Wireman)			\$38.53	13	72	\$18.17 + 10%
Electrician (Outside-Line Construction)\Lineman	6/18		\$44.26	125	65	\$5.50 + 34.5%
Lineman Operator	6/18		\$40.91	125	65	\$5.50 + 34.5%
Groundman	6/18		\$28.53	125	65	\$5.50 + 34.5%
Elevator Constructor	6/18	a	\$46.91	26	54	\$34.355
Glazier	6/18		\$35.00	88	32	\$18.39
Ironworker	6/18		\$33.30	50	4	\$29.65
Laborer (Building):						
General	6/18		\$28.45	30	4	\$16.15
First Semi-Skilled	6/18		\$28.85	30	4	\$16.15
Second Semi-Skilled	6/18		\$29.25	30	4	\$16.15
Lather			USE CARPENTER RATE			
Linoleum Layer and Cutter	6/18		\$36.51	46	67	\$17.10
Marble Mason			\$35.16	25	4	\$14.11
Marble Finisher			\$24.58	25	4	\$8.92
Millwright			USE CARPENTER RATE			
Operating Engineer						
Group I	6/18		\$38.74	85	4	\$18.02
Group II	6/18		\$37.93	85	4	\$18.02
Group III	6/18		\$32.38	85	4	\$18.02
Group III-A	6/18		\$36.59	85	4	\$18.02
Group IV						
Group V	6/18		\$33.98	85	4	\$18.02
Painter	6/18		\$30.14	37	4	\$17.16
Pipe Fitter			\$44.48	2	33	\$21.15
Plasterer	6/18		\$32.07	68	4	\$17.63
Plumber	6/18		\$45.34	45	33	\$21.89
Pile Driver						
Roofer \ Waterproofor	6/18		\$32.95	95	2	\$18.89
Sheet Metal Worker			\$40.90	17	22	\$22.99
Sprinkler Fitter - Fire Protection			\$37.74	14	4	\$20.02
Terrazzo Worker			\$35.16	25	4	\$14.11
Terrazzo Finisher			\$24.58	25	4	\$8.92
Tile Setter			\$35.16	25	4	\$14.11
Tile Finisher			\$24.58	25	4	\$8.92
Traffic Control Service Driver			\$15.35	48	49	\$2.71
Truck Driver-Teamster						
Group I			\$30.09	100	4	\$10.90
Group II			\$30.09	100	4	\$10.90
Group III			\$30.29	100	4	\$10.90
Group IV			\$30.29	100	4	\$10.90

Fringe Benefit Percentage is of the Basic Hourly Rate

**Annual Incremental Increase

Building Construction Rates for
JACKSON County Footnotes

Section 048

OCCUPATIONAL TITLE	** Date of Increase	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits

* Welders receive rate prescribed for the occupational title performing operation to which welding is incidental.

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

a - Vacation: Employees over 5 years - 8%; Employees under 5 years - 6%

**REPLACEMENT PAGE
JACKSON COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 2: Means the maximum of eight (8) hours shall constitute a day's work beginning at 8:00 a.m. to 12:00 noon, 12:30 p.m. to 4:30 p.m. The maximum work week shall be forty (40) hours beginning Monday at 8:00 a.m. and ending Friday at 4:30 p.m. Because of traffic, parking or other circumstances, the hours of work on any project may be any continuous 8½ hours period (8 hours of work plus 30 minutes for lunch) between 7:00 a.m. and 4:30 p.m. When circumstances warrant and when it is mutually beneficial and agreed to, the Employer may institute a work week consisting of four (4) consecutive ten (10) hour days, between the hours of 7:00 a.m. and 6:00 p.m. Monday through Thursday, with one-half (½) hour allowed for a lunch period each day. Friday may be used as a make-up day. After ten (10) hours in a workday, or forty (40) hours in a workweek, overtime shall be paid at a rate of one and one-half (1½) times the regular rate of pay. Overtime performed Monday through Saturday shall be paid at the rate of one and one-half (1½) times the regular rate of pay. Sundays and recognized holidays shall be paid at the double (2) time rate of pay. Labor Day shall be paid at triple (3) time. Shift work may be performed at the option of the Contractor. However, whenever shift work is performed it must cover a period not less than (5) consecutive working days. The day shift shall work a regular eight (8) hours shift as outlined above. Employees working a second shift shall receive an additional \$0.25 above the regular hourly rate and perform seven and one-half (7½) hours work for eight (8) hours pay. Third shift employees shall be paid an additional \$0.50 above the regular hourly rate and work seven (7) hours for eight (8) hours pay. In the event a first shift is not required, a second and third shift employee shall receive an additional 15% of the base rate and receive pay for actual hours worked.

NO. 13: Means a regular workday shall consist of eight (8) hours between 8:00 a.m. and 4:30 p.m. Forty (40) hours, within five (5) days -- Monday through Friday inclusive -- shall constitute the regular workweek. The Employer may alter the above stated hours by two (2) hours for an early starting and quitting time only, not to exceed eight (8) hours of work in any one day. When job conditions dictate and as required by the customer, the Employer shall be allowed to establish a four (4) day, ten (10) hour per day work week. This work week is defined as Monday through Thursday, with a Friday make-up day. The normal work day under a ten (10) hour four (4) day work week shall be from 7:00 a.m. to 6:00 p.m., with a one hour starting variance. The make-up day of Friday shall be instituted for specific reasons such as loss of production due to weather and/or holidays. All hours worked in excess of ten (10) hours per day or forty (40) hours per week or hours worked outside the normal work week shall be paid at the applicable overtime rate. The first four (4) hours of overtime after the normal workday, each day Monday through Friday and the first ten (10) hours of overtime on Saturdays shall be paid for at one and one-half (1½) times the regular straight time rate of pay. All other work performed outside of the regularly scheduled working hours and outside of the first ten (10) hours worked on Saturdays shall be paid for at double (2) the regular straight time rate of pay. Sundays and the recognized holidays shall be paid for at double (2) the regular straight time rate of pay, if worked. When so elected by the contractor, multiple shifts of at least five (5) days duration may be worked. When two (2) or three (3) shifts are worked: The first shift (day shift) shall be worked between the hours of 8:00 a.m. and 4:30 p.m. Workmen on the "day shift" shall receive eight (8) hours pay at the regular hourly rate for eight (8) hours work. The second shift (swing shift) shall be worked between the hours of 4:30 p.m. and 12:30 a.m. Workmen on the "swing shift" shall receive eight (8) hours pay at the regular hourly rate plus 10% for seven and one-half (7 ½) hours work. The third shift (graveyard shift) shall be worked between the hours of 12:30 a.m. and 8:00 a.m. Workmen on the "graveyard shift" shall receive eight (8) hours pay at the regular hourly rate plus 15% for seven (7) hours work. A lunch period of thirty (30) minutes shall be allowed on each shift. All overtime work required after the completion of a regular shift shall be paid at one and one-half (1½) times the "shift" hourly rate.

NO. 14: Means eight (8) hours per day shall constitute a day's work. The regular starting time shall be 8:00 a.m., and the regular quitting time shall be 4:30 p.m.; lunch time shall be twelve (12) o'clock noon to 12:30 p.m. The regular starting time may, by mutual consent of employees on the job site, and the employer, be between 7:00 a.m. and 9:00 a.m. with appropriate adjustments made to the regular quitting time and lunch time. All time worked before the regular starting time and after the regular quitting time, Monday through Friday, shall be paid at the rate of time and one-half (1½). Four (4) days at ten (10) hours a day may be worked at straight time. All work commencing with the beginning of the established work day on Saturday shall be paid at the rate of time and one-half (1½). All work commencing with the beginning of the established work day on Sundays and/or Holidays shall be paid at the rate of double (2) time.

**REPLACEMENT PAGE
JACKSON COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 17: Means the regular working day shall consist of eight (8) hours of labor between 7:00 a.m. and 3:30 p.m. and the regular work week shall consist of five (5) consecutive eight (8) hour days of labor beginning on Monday and ending with Friday of each week. All full-time or part-time labor performed during such hours shall be recognized as regular working hours and paid for at the regular hourly rate. Except as otherwise provided, all work performed outside of regular working hours during the regular work week, shall be at double (2) times the regular rate. Working hours may be varied by two (2) hours. When circumstances warrant and when it is mutually beneficial and agreed to by interested parties, the Employer may institute a work week consisting of four (4) consecutive ten (10) hour days, between the hours of five (5) a.m. and six (6) p.m., Monday through Thursday, with one-half (1/2) hour allowed for a lunch period each day. Friday may be used as a make-up day. The make-up day will be voluntary, and a decision not to work may not be held against the employee. When working four (4) ten (10) hour day's overtime will be paid at the time and one-half (1½) rate for the eleventh (11th) and twelfth (12th) hour, all other work will be paid at the double (2) time rate of pay. The first two (2) hours of overtime, Monday through Friday, and the first eight (8) hours on Saturday shall be at time and one-half (1½) for all work. All other overtime shall be at double (2) time. The first two (2) hours of overtime must be concurrent with the regular work day; two (2) hours prior to or following the regular work day are at time and one-half (1½). The regular workday (as previously defined) on Saturday is paid at time and one-half (1½). Work performed outside of the regular Saturday work day is at double (2) time. All work performed on recognized holidays, or days locally observed as such, and Sundays shall be paid at the double (2) time rate of pay.

NO. 25: Means forty (40) hours (5-8's) shall constitute a regular workweek, anything over eight (8) hours per day shall be paid for at one and one-half times the regular hourly rate. Work may be scheduled on a four days a week (Monday through Thursday) at 10 hours a day scheduled between 6:00 a.m. and 6:00 p.m. at the regular hourly rate understanding that anything over ten (10) hours per day shall be paid for at one and one-half times the regular hourly rate. Employment from 6:00 p.m. and 6:00 a.m. Monday through Friday shall be paid for at one and one-half times the regular hourly rate. For work scheduled on Saturday, all hours worked shall be paid for at one and one-half times the regular hourly rate. For work scheduled on Sunday, any hours worked shall be paid for at twice the regular hourly rate. Hours worked on Holidays will be paid at double time wages except for Veteran's Day.

NO. 26: Means that the regular working day shall consist of eight (8) hours worked between 6:00 a.m., and 5:00 p.m., five (5) days per week, Monday to Friday, inclusive. Hours of work at each jobsite shall be those established by the general contractor and worked by the majority of trades. (The above working hours may be changed by mutual agreement). Work performed on Construction Work on Saturdays, Sundays and before and after the regular working day on Monday to Friday, inclusive, shall be classified as overtime, and paid for at double (2) the rate of single time. The employer may establish hours worked on a jobsite for a four (4) ten (10) hour day work week at straight time pay for construction work; the regular working day shall consist of ten (10) hours worked consecutively, between 6:00 a.m. and 6:00 p.m., four (4) days per week, Monday to Thursday, inclusive. Any work performed on Friday, Saturday, Sunday and holidays, and before and after the regular working day on Monday to Thursday where a four (4) ten (10) hour day workweek has been established, will be paid at two times (2) the single time rate of pay. The rate of pay for all work performed on holidays shall be at two times (2) the single time rate of pay.

NO. 30: Means Monday through Sunday shall constitute the work week. Regular starting time shall be 8:00 A.M., except when the work week is scheduled as a week with starting time advanced or delayed. Starting time may be advanced or delayed by the employer up to two (2) hours from the regular starting time. Eight (8) hours shall constitute the work day. All work performed prior to or after the regular eight (8) hour work day, as described above, and all work performed on Saturday shall be paid at time and one-half (1½) the regular rate. In the event that a scheduled eight (8) hour work day is missed (not to include holidays) because of events out of the control of the contractor, then that missed work day may be made up at straight time the following Saturday. It is recognized that not all employees working on a Saturday make-up day will have worked the same number of hours during the regular work week. It is further recognized that any work after the forty (40) hours in a week must be paid at time and one-half (1½). Saturday make-up day shall not be used to make up for time lost due to recognized holidays. The employer may establish a 4-10's schedule on projects (4 days with 10 hours per day). If using a 4-10's schedule, a Friday make-up day is allowed. If using a 4 (10) schedule, any work more than ten (10) hours in a day or forty (40) hours in a work week shall be paid at the time and one-half (1½) rate. Friday make-up day shall not be used to make up for time lost due to recognized holidays. All work performed on Sundays or holidays shall be paid at the double (2) time rate.

**REPLACEMENT PAGE
JACKSON COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 37: The Employer may choose, at his discretion, to work five eight hour days or four ten hour days with a Friday make-up day, Monday through Friday at straight time. Overtime shall be paid after eight (8) hours when working "five eights" and after ten hours when working "four tens". All work performed on Sundays and recognized holidays shall be paid for at the rate of double (2) time. All Saturday work shall be paid for at the rate of time and one-half (1½) the regular wage rate. All night work during the regular work week other than the above-mentioned days shall be paid for at the rate of time and one-half (1½) the regular wage scale until midnight and double (2) time after midnight except make-up time will be allowed under the following condition: In the event of inclement weather on exterior projects which prevents working the full regular eight (8) hour day, forty (40) hour work week schedule, a Saturday make-up day can be granted. Then said work on Saturday shall be paid at the straight time rate of pay up to a maximum total of forty (40) hours per week.

NO. 45: Means eight (8) hours shall constitute a day's work, beginning at 8:00 a.m. and ending at 4:30 p.m. The regular work week shall be forty (40) hours, beginning Monday, 8:00 a.m. and ending at 4:30 p.m. Friday. Because of traffic, parking and other circumstances, the hours of work on any project may begin as early as 6:00 a.m. with eight (8) hours worked between 6:00 a.m. and 4:30 p.m. When circumstances warrant and when it is mutually beneficial and agreed to, the employer may institute a work week consisting of four (4) consecutive ten (10) hour days, between the hours of 7:00 a.m. and 6:00 p.m., Monday through Thursday. Friday may be used as a make-up day. After ten (10) hours in a workday, or forty (40) hours in a workweek, overtime shall be paid at a rate of one and one-half (1½) times the regular rate of pay. All overtime Monday through Saturday shall be paid at the rate of time and one-half (1½) the regular rate of pay. Sunday and recognized holidays shall be paid at double (2) time. Labor Day shall be paid at triple (3) time. Shift work may be performed at the option of the Contractor. However, whenever shift work is performed it must cover a period not less than (5) consecutive working days. The day shift shall work a regular eight (8) hours shift as outlined above. The hourly rate for second shift (seven and one-half hours worked for eight hours paid) shall be twenty-five cents (\$0.25) over and above the hourly rate. The hourly rate for third shift (seven hours worked, eight hours paid) shall be fifty cents (\$0.50) above the hourly rate. If no first shift is worked, second and third shift employees shall receive an additional fifteen percent (15%) over and above the hourly rate for actual hours worked.

NO. 46: Means the regular work day shall be eight (8) hours from 6:00 a.m. to 6:30 p.m. Starting time may be between 6:00 a.m. and 10:00 a.m. The regular work week shall be forty (40) hours, beginning between 6:00 a.m. and 10:00 a.m. on Monday and ending between 2:30 p.m. and 6:30 p.m. on Friday. All hours in excess of the regular work day and work week shall be considered overtime. Overtime on days recognized as regular work days and on Saturday shall be paid for at the rate of time and one-half (1½) the regular rate. Sunday and recognized holidays shall be paid for at the rate of double time (2) for time worked. The Employer may establish a work week consisting of four (4) days, Monday through Thursday, each day consisting of ten (10) hours at straight time rate of pay. The 4-10's must run for a period of at least four (4) days.

NO 47: Means a regular workday shall consist of eight (8) hours between 6:00 a.m. and 6:30 p.m. Forty (40) hours, within five (5) days -- Monday through Friday or Tuesday through Saturday inclusive -- shall constitute the regular workweek. The Employer may alter the above stated hours by two (2) hours for an early starting and quitting time only, not to exceed eight (8) hours of work in any one day. The Employer shall be allowed to establish a four (4) day, ten (10) hour per day work week. This work week is defined as Monday through Thursday, with a Friday make-up day. The normal work day under a ten (10) hour four (4) day work week shall be from 7:00 a.m. to 6:00 p.m. All hours worked in excess of ten (10) hours per day or forty (40) hours per week or hours worked outside the normal work week shall be paid at the applicable overtime rate. The first four (4) hours of overtime after the normal workday, each day Monday through Friday and the first ten (10) hours of overtime on Saturdays shall be paid for at one and one-half (1½) times the regular straight time rate of pay. All other work performed outside of the regularly scheduled working hours and outside of the first ten (10) hours worked on Saturdays shall be paid for at double (2) the regular straight time rate of pay. Sundays and the recognized holidays shall be paid for at double (2) the regular straight time rate of pay, if worked. When so elected by the contractor, multiple shifts of at least five (5) days duration may be worked. When two (2) or three (3) shifts are worked: The first shift (day shift) shall be worked between the hours of 8:00 a.m. and 4:30 p.m. Workmen on the "day shift" shall receive eight (8) hours pay at the regular hourly rate for eight (8) hours work. The second shift (swing shift) shall be worked between the hours of 4:30 p.m. and 12:30 a.m. Workmen on the "swing shift" shall receive eight (8) hours pay at the regular hourly rate plus 10% for seven and one-half (7 ½) hours work. The third shift (graveyard shift) shall be worked between the hours of 12:30 a.m. and 8:00 a.m. Workmen on the "graveyard shift" shall receive eight (8) hours pay at the regular hourly rate plus 15% for seven (7) hours work. A lunch period of thirty (30) minutes shall be allowed on each shift. All overtime work required after the completion of a regular shift shall be paid at one and one-half (1½) times the "shift" hourly rate.

**REPLACEMENT PAGE
JACKSON COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 48: Means the regularly scheduled work week shall be five (5) consecutive days, Monday through Friday or Tuesday through Saturday. Eight (8) hours shall constitute a day's work. Starting time shall not be earlier than 7:00 a.m. nor later than 10:00 a.m. Forty (40) hours shall constitute a week's work. Overtime at the rate of time and one-half (1½) will be paid for all work in excess of forty (40) hours in any one work week. On the Monday through Friday schedule, all work performed on Saturday will be time and one-half (1½) unless time has been lost during the week, in which case Saturday will be a makeup day to the extent of the lost time. On the Tuesday through Saturday schedule, all work performed on Monday will be time and one-half (1½) unless time has been lost during the week, in which case Monday will be a make-up day to the extent of the lost time. Any work performed on Sunday will be double (2) time. If employees work on any of the recognized holidays, they shall be paid time and one-half (1½) their regular rate of pay for all hours worked.

NO. 50: Means eight (8) hours constitute a normal day's work Monday through Friday. Any time worked over eight (8) hours will normally be paid at time and one-half (1½) except for exclusions stated in some following additional sentences. The Employer, at his discretion, may start the work day between 6:00 a.m. and 9:00 a.m. Any schedule chosen shall be started at the beginning of the work week (Monday) and used for at least five days. Work may be scheduled on a four (4) days a week (Monday through Thursday) at ten (10) hours a day schedule. If such a schedule is employed, then Friday may be used as a make-up day when time is lost due to inclement weather. Time and one-half (1½) shall be paid for any work in excess of eight (8) hours in any regular work day Monday through Friday unless working 4-10's, then time and one-half (1½) after ten (10) hours. All work performed on Saturday will be time and one-half (1½). Double (2) time shall be paid for all work on Sundays and recognized holidays.

NO. 52: Means the regular workweek shall consist of five (5) eight (8) hour days, Monday through Friday. The regular workday shall consist of an eight (8) hour period, to be worked between the agreed upon starting time and ending no later than 4:30 p.m. The agreed upon starting time shall be any time between the hours of 6:00 a.m. and 8:00 a.m. The option exists for the employer to use a four (4) day, ten (10) hour work week. Days worked shall be Monday through Thursday or Tuesday through Friday. If the job requires men on duty all five (5) days, then part of the crew may work the first four (4) days and the remainder of the crew may work the last four (4) days. Hours each day shall be from 7:00 a.m. to 5:30 p.m. Interested parties on the project must agree to this clause before it may be used. Once this clause has been put into effect, it shall remain as long as the majority of the Employees on the project and the Employer agree to keep it. The four (4) day clause shall not be used to circumvent a Holiday. Except as otherwise provided, all work performed outside the regular working hours and performed during the regular work week (Monday through Friday) shall be at the following rates of pay:

Holidays-New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, Christmas Day (or days observed as such) shall be recognized as Holidays that shall be paid at two (2) times the regular rate of pay.

Labor Day-No work shall be performed on Labor Day except in special cases of emergency. Rate of pay shall be at three (3) times the regular rate of pay.

Overtime-Work performed outside of the regular work day (the regular work day shall consist of an eight (8) hour period, to be worked between the agreed upon starting time and ending not later than 4:30 p.m. The agreed upon starting time shall be any time between the hours of 6:00 a.m. and 8:00 a.m., by mutual consent of the interested party's.), shall be:

- A. Hours worked Monday through Friday, the first two (2) hours of overtime will be paid at time and one-half (1½). All other overtime will be paid at the double (2) time rate.
- B. The first ten (10) hours worked on Saturday will be paid at time and one-half (1½), with all other hours to be paid at the double (2) time rate.
- C. Sundays and Holidays (except Labor Day) shall be paid at the double (2) time rate.

**REPLACEMENT PAGE
JACKSON COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 57: Means eight (8) hours per day shall constitute a day's work and forty (40) hours per week, Monday through Friday, shall constitute a week's work. The regular starting time shall be 8:00 a.m. If a second or third shift is used, the regular starting time of the second shift shall be 4:30 p.m. and the regular starting period for the third shift shall be 12:30 a.m. These times may be adjusted by the employer. The day shift shall work a regular eight (8) hours shift as outlined above. Employees working a second shift shall receive an additional \$0.25 above the regular hourly rate and perform seven and one-half (7½) hours work for eight (8) hours pay. Third shift employees shall be paid an additional \$0.50 above the regular hourly rate and work seven (7) hours for eight (8) hours pay. When circumstances warrant, the Employer may change the regular workweek to four (4) ten-hour days at the regular time rate of pay. All time worked before and after the established workday of eight (8) hours, Monday through Friday, and all time worked on Saturday shall be paid at the rate of time and one-half (1½) except in cases where work is part of an employee's regular Friday shift. All time worked on Sunday and recognized holidays shall be paid at the double (2) time rate of pay except in cases where work is part of an employee's previous day's shift. For all overtime hours worked \$27.51 of the fringe benefits portion of the prevailing wage shall be paid at the same overtime rate at which the cash portion of the prevailing wage is to be paid. The remaining \$1.87 of the fringe benefit portion of the prevailing wage may be paid at straight time.

NO. 58: Means eight (8) consecutive hours, between 6:00 a.m. and 5:30 p.m., shall constitute a day's work. Five (5) day's work, Monday through Friday, shall constitute a normal work week. Work performed in excess of eight (8) hours per day or eight hours beyond normal starting time for that project excluding lunch Monday through Friday, and all work performed on Saturday, shall be paid for the rate of time and one-half (1½). When Sundays and recognized holidays are worked, the worker(s) shall be paid at the rate of double (2) time. Work may be scheduled on a four (4) days a week (Monday through Thursday) at ten (10) hours a day schedule at straight time. A Friday make-up day is available if time is lost due to inclement weather and at least sixteen (16) hours, but not more than thirty (30) hours, were worked during the week.

NO. 63: Means eight (8) hours shall constitute the regular work day between time that may be advanced or delayed by two (2) hours on either side of 8:00 AM. The Employer may establish a work week consisting of four (4) days, Monday through Thursday, each day consisting of ten (10) hours straight time. The four (4) tens (10s) must run for a period of at least four (4) days, Monday through Thursday. All work on Friday on a four (4) tens (10) project will be paid at the rate of time and one-half (1½). All work performed on Saturday shall be paid at time and one-half (1½). All work performed on Sundays and recognized holidays must be paid at double (2) time. All work performed prior to or after the regular eight (8) hour work day, or ten (10) hour work day, as described above shall be paid at time and one-half (1½) the regular rate.

NO. 65: Means Monday through Sunday shall constitute the work week. Regular starting time shall be 8:00 a.m., with one half hour for lunch between three and one-half (3½) and five (5) hours after starting time. The starting time may be advanced by two (2) hours or delayed one (1) hour by the employer from the regular starting time. All work performed before the advanced starting time and during the half hour lunch shall be paid at the overtime rate of time and one-half (1½). Work performed outside these hours shall be paid at the overtime rate of time and one-half (1½), except as provided otherwise below. All work performed on Sundays or recognized holidays shall be paid at the double (2) time rate. When the start time is delayed past 9:00 a.m., the employee's pay shall start at 9:00 a.m. and all time, after the normal quitting time (5:30 p.m.), shall be paid at the overtime rate. Eight (8) hours shall constitute the work day. All work performed prior to or after the regular eight (8) hour work day, as described above, and all work performed on Saturday shall be paid at time and one-half (1½) the regular rate. In the event that a scheduled eight (8) hour work day is missed (not including recognized holidays) because of inclement weather, then that missed work day may be made up at straight time on the following Saturday. It is recognized that not all employees working on a Saturday make-up day will have worked the same number of hours during the regular work week. It is further recognized that any work after forty (40) hours must be paid at time and one-half (1½). The employer may establish a 4-10's schedule on projects (4 days with 10 hours per day at straight time). In order to use the 4-10's schedule, the employer must schedule the 4-10's for a minimum of one (1) week. If using a 4-10's schedule, a Friday make-up day is allowed.

**REPLACEMENT PAGE
JACKSON COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 68: Means Monday through Sunday shall constitute the work week. Regular starting time shall be 8:00 a.m., with one half hour for lunch between three and one-half and five hours after starting time. The starting time may be advanced or delayed by the employer up to one hour from the regular starting time. All work performed before the advance starting time and during the half hour lunch shall be paid at the overtime rate of time and one-half (1½). Work performed outside these hours shall be paid at the overtime rate of time and one-half (1½), except as provided otherwise below. All work performed on Sundays or holidays shall be paid at the double (2) time rate. Eight (8) hours shall constitute the work day. All work performed prior to or after the regular eight (8) hour work day, as described above, and all work performed on Saturday shall be paid at time and one-half (1½) the regular rate, except as hereinafter described. In the event that a scheduled eight (8) hour work day is missed (not including recognized holidays) because of inclement weather, then that missed work day may be made up at straight time on the Saturday in the week of the pay period. It is recognized that not all employees working on a Saturday make-up day will have worked the same number of hours during the regular work week. It is further recognized that any work after forty (40) hours must be paid at time and one-half (1½). The employer may establish a 4-10's schedule on projects (4 days with 10 hours per day at straight time). In order to use the 4-10's schedule, the employer must schedule the 4-10's for a minimum of one (1) week. If using a 4-10's schedule, a Friday make-up day is allowed.

NO. 85: Means the work week shall be Monday through Sunday. Eight (8) hours shall constitute a day's work to begin between 6:00 a.m. and 9:00 a.m. and end between 2:30 p.m. to 5:30 p.m. Employees required to work during their lunch period shall receive the overtime rate. Employees shall receive time and one-half (1½) for all time they are required to work prior to their normal starting time or after eight (8) hours or normal quitting time Monday through Friday, or all day on Saturday. If an Employer has started the work week on a five day, eight hours a day schedule, and due to inclement weather misses any time, then he may switch to a nine or ten hours a day schedule, at straight time, for the remainder of that work week in order to make up for the lost time (10-hour make-up day). All work over ten (10) hours a day or over forty (40) hours a week must be paid at time & one-half (1½). Sundays and recognized holidays shall be paid at the double (2) time rate of pay. A contractor may alter the regular work week to four (4) ten (10) hour days at straight time rate of pay. To do this the scheduled 4-10's must be worked at least one full week and the regular workweek shall be Monday through Thursday with Friday being a make-up day at straight time for days missed in the regular workweek due to inclement weather. If 5-8's are being worked, Saturday may be used as a make-up day at straight time if inclement weather prevents work during the normal work week.

NO. 88: Means the regular work week shall consist of five (5) eight (8) hour days, 7:00 a.m. to 3:30 p.m., Monday through Friday, except when the work week is scheduled as a 4-10's week or as a week with start time advanced or delayed as described below. The starting time may be advanced or delayed by one hour on either side of 7:00 a.m. The advanced or delayed starting time must run for a period of at least five (5) days. The Employer may establish a work week consisting of four (4) days, during the regular work week, each day consisting of ten (10) hours at straight time. The 4-10's must run for a period of at least four (4) days. Time and one-half (1½) shall be paid for any work in excess of eight (8) hours in any regular work day Monday through Friday (or ten hours in a 4-10's week), the first eight (8) hours of a Saturday, and it shall be at time and one-half (1½) for the Friday and Saturday following Thanksgiving. Double (2) time shall be paid for the following time worked on Sunday, New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day, as well as any work in excess of eight (8) hours on a Saturday and the Saturday of a three-day weekend (except the Saturday following Thanksgiving).

NO. 95: Means a regular workday shall consist of eight and one-half (8½) hours elapsed time, including one-half hour for lunch. The crew starting times shall be flexible within the period of daylight to 8:00 a.m. Any work performed over ten (10) hours of elapsed time per day including one-half hour for lunch and/or any work performed over forty (40) hours at the straight time rate in one week shall be paid at time and one-half (1½) the straight time rate. Saturday shall be a voluntary make-up day at straight time at the discretion of the contractor and with the consent of the employees. Sunday and recognized holidays shall be paid for at double (2) time.

**REPLACEMENT PAGE
JACKSON COUNTY
BUILDING CONSTRUCTION - OVERTIME SCHEDULE**

NO. 100: Means eight (8) hours shall constitute a day's work, and five (5) continuous eight-hour days shall constitute a week's work, Monday through Friday. Time and one-half (1½) the regular hourly rate shall be paid for all work performed in excess of eight (8) hours in any one day or forty (40) hours in any one week. Starting time shall be between 6:00 a.m. and 9:00 a.m. All work over eight (8) hours in a regular 5-day 8-hour schedule shall be at the appropriate overtime rate. All time worked before the regular scheduled starting time shall be paid for at the rate of time and one-half (1½) and shall not apply to regular shift. All time worked after eight (8) hours in any one day or after 5:30 p.m., whichever comes first, shall be paid at the time and one-half (1½) rate. An Employer, at his option, may elect to work four (4) ten (10) hour days, Monday through Thursday, at straight time. All such work must be done at least one week in duration. All work over ten (10) hours in one day or forty (40) hours in a week shall be at the overtime rate. Any employee who is scheduled to work on any regular work day but is prevented from working because of weather conditions, shall be permitted to work on Saturday (Friday if working 4-10's) as a make-up day at the straight time rate of pay. When an employee is required to work on any recognized holiday they shall receive the double (2) time rate for all time that they are required to perform work. All time worked from 12:00 Midnight Saturday to 12:00 Midnight Sunday shall be paid for at the rate of double (2) time on single shift.

NO. 125: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.

JACKSON COUNTY BUILDING CONSTRUCTION - HOLIDAY SCHEDULE

NO. 2: All work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or the days observed as such, shall be paid at the double time rate of pay.

NO. 4: All work done on New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day and Christmas Day shall be paid at the double time rate of pay. If any of the above holidays fall on Sunday, Monday will be observed as the recognized holiday. If any of the above holidays fall on Saturday, it will be celebrated on Saturday.

NO. 7: The following days are assigned days and are recognized as holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, and Christmas Day. If a holiday falls on a Sunday, it shall be observed on the following Monday. If a holiday falls on a Saturday, it shall be observed on the preceding Friday. No work shall be performed on Labor Day except in case of jeopardy to work under construction. This is applied to protect Labor Day. When a holiday falls during the normal work week, Monday through Friday, it shall be counted as eight (8) hours toward the forty (40) hour week. However, no reimbursement for these eight (8) hours is to be paid to the workman unless worked. If workman are required to work the above enumerated holidays or days observed as such, or on Sunday, they shall receive double (2) the regular rate of pay for such work.

NO. 22: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day, or days locally observed as such, and Sunday shall be recognized as holidays. If a holiday falls on Saturday, Friday shall be observed; if it falls on Sunday, Monday shall be observed. All work performed on holidays shall be paid at the double (2) time rate of pay.

NO. 32: All work performed for the Friday and Saturday following Thanksgiving shall be paid at the time and one-half (1½) rate of pay. All work performed on Sundays, New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day shall be paid at the double (2) time rate of pay. When one of the above holidays falls on Sunday, the following Monday shall be observed and when one of the above holidays falls on Saturday, the preceding Friday shall be observed.

NO. 33: All work done on New Year's Day, Memorial Day, Fourth of July, Thanksgiving Day and Christmas Day shall be paid at the double time rate of pay. Labor Day shall be paid at the triple (3) time rate of pay. If the holiday falls on Sunday, the following Monday will be observed; if the holiday falls on Saturday, the preceding Friday will be observed.

NO. 39: No work shall be done on the following holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas. Any of these holidays falling on Sunday, the following Monday shall be a holiday, and any of these holidays falling on Saturday, the preceding Friday shall be a holiday.

NO. 49: The following days shall be observed as legal holidays: New Year's Day, Decoration Day, July 4th, Labor Day, Thanksgiving Day, Christmas Day, Employee's birthday and two (2) personal days. The observance of one (1) of the personal days to be limited to the time between December 1 and March 1 of the following year. If any of these holidays fall on Sunday, the following Monday will be observed as the holiday and if any of these holidays fall on Saturday, the preceding Friday will be observed as the holiday. If employees work on any of these holidays they shall be paid time & one-half (1½) their regular rate of pay for all hours worked.

NO. 53: All work done on New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, Christmas Day or days observed as such for these holidays shall be paid at the double (2) time rate of pay. No work shall be performed on Labor Day except in special cases of emergency, and then the rate of pay shall be at three (3) times the regular rate of pay. When a holiday falls on a Sunday, the following Monday shall be observed as the holiday. When a holiday falls on Saturday, the preceding Friday shall be observed as the holiday.

NO. 54: All work performed on New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, and Christmas Day shall be paid at the double (2) time rate of pay. When a holiday falls on Saturday, it shall be observed on Friday. When a holiday falls on Sunday, it shall be observed on Monday.

**JACKSON COUNTY
BUILDING CONSTRUCTION - HOLIDAY SCHEDULE**

NO. 65: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 67: All work performed on New Year's Day, Memorial Day, Christmas Day, Fourth of July and Thanksgiving Day, from midnight to midnight, shall be paid for at the rate of double time (2) the basic rate of pay if required to work in addition to any other pay otherwise required hereunder as holiday pay. Positively no work shall be performed on Labor Day. Martin Luther King's Birthday, Veteran's Day, and the day after Thanksgiving Day shall be considered optional holidays, and if the Employer and employees agree that work will be performed on that day, no premium pay will be required. Should any of the above holidays fall on Saturday; the holiday will be observed on Friday. Should any of the above holidays fall on Sunday, the holiday will be observed on Monday.

NO. 68: All work performed on New Year's Day, Decoration Day (Memorial Day), Independence Day (Fourth of July), Labor Day, Thanksgiving Day, Christmas Day, or days observed as such, shall be paid at the rate of double (2) time. When a holiday falls on a Saturday, Friday shall be observed. When a holiday falls on a Sunday, Monday shall be observed. No work shall be performed on the Fourth of July or Labor Day except to save life or property. Where one of the holidays specified falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO. 72: All work performed on New Year's Day, Memorial Day (last Monday in May), Independence Day, Labor Day, Thanksgiving Day and Christmas Day shall be paid for at double (2) the regular straight time rate of pay. Any one of the above listed holidays falling on Sunday shall be observed on the following Monday and paid for at double (2) the regular straight time rate of pay, if worked. Any one of the above listed holidays falling on Saturday shall be observed on the prior Friday and paid for at double (2) the regular straight time rate of pay, if worked. No work shall be performed on Labor Day except in case of emergency.

OCCUPATIONAL TITLE	* Date of Increase	Basic Hourly Rates	Over-Time Schedule	Holiday Schedule	Total Fringe Benefits
Carpenter		\$37.73	1	17	\$16.85
Cement Mason	6/18	\$31.83	3	2	\$17.39
Electrician (Outside-Line Construction)\Lineman)	6/18	\$44.26	18	24	\$5.50 + 34.5%
Lineman Operator	6/18	\$40.91	18	24	\$5.50 + 34.5%
Lineman - Tree Trimmer	6/18	\$23.02	31	30	\$5.75 + 28%
Groundman	6/18	\$28.53	18	24	\$5.50 + 34.5%
Groundman - Tree Trimmer	6/18	\$18.62	31	30	\$5.75 + 28%
Laborer					
General Laborer	6/18	\$30.18	3	2	\$15.63
Skilled Laborer	6/18	\$31.39	3	2	\$15.63
Millwright		\$37.73	1	17	\$16.85
Operating Engineer					
Group I	6/18	\$36.22	3	2	\$17.99
Group II	6/18	\$35.18	3	2	\$17.99
Group III	6/18	\$35.18	3	2	\$17.99
Group IV	6/18	\$30.71	3	2	\$17.99
Oiler-Driver	6/18	\$34.06	3	2	\$17.99
Pile Driver		\$37.73	1	17	\$16.85
Traffic Control Service Driver		\$29.58	FED		\$15.23
Truck Driver-Teamster					
Group I	6/18	\$32.09	3	2	\$15.25
Group II	6/18	\$32.09	3	2	\$15.25
Group III	6/18	\$32.09	3	2	\$15.25
Group IV	6/18	\$32.09	3	2	\$15.25

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate sheet.

JACKSON COUNTY HEAVY CONSTRUCTION - OVERTIME SCHEDULE

FED: Minimum requirement per Fair Labor Standards Act means time and one-half (1½) shall be paid for all work in excess of forty (40) hours per work week.

NO. 1: Means (8) hours shall constitute the regular work day between time that may be advanced or delayed by two (2) hours on either side of 8:00 AM. The Employer may establish a work week consisting of four (4) days, Monday through Thursday, each day consisting of ten (10) hours straight time. The four (4) tens (10s) must run for a period of at least four (4) days, Monday through Thursday. All work on Friday on a four (4) tens (10) project will be paid at the rate of time and one-half (1½). All work performed on Saturday shall be paid at time and one-half (1½). All work performed on Sundays and recognized holidays must be paid at double (2) time. All work performed prior to or after the regular eight (8) hour work day, or ten (10) hour work day, as described above shall be paid at time and one-half (1½) the regular rate.

NO. 3: Means a regular work week shall consist of not more than forty (40) hours of work and all work performed over and above ten (10) hours per day or forty (40) hours per week shall be paid at the rate of time & one-half (1½). Workers shall receive time and one-half (1½) for all work performed on Sundays and recognized holidays. Double (2) time shall be paid for work performed on Sundays or recognized holidays when and only if any other craft employees of the same employer at work on that same job site are receiving double (2) time pay for that Sunday or Holiday work. A work day is to begin between 6:00 a.m. and 9:00 a.m. at the option of the Employer except when inclement weather or other conditions beyond the reasonable control of the Employer prevents work, in which event, the starting time may be delayed, but not later than 12:00 noon. Where one of the recognized holidays falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO. 18: Eight (8) hours of work between the hours of 8:00 a.m. and 4:30 p.m. shall constitute a work day. Forty (40) hours within the five (5) days, Monday through Friday inclusive, shall constitute the work week. Starting time may be adjusted not to exceed two (2) hours. Work performed outside of the aforementioned will be paid at the applicable overtime rate. When starting time has been adjusted, all other provisions concerning the work day shall be adjusted accordingly. The overtime rate of pay shall be one and one-half (1½) times the regular rate of wages, other than on Sundays, holidays and from Midnight until 6:00 a.m., which will be paid at double (2) the straight time rate.

NO. 31: Means the overtime rate shall be time and one-half the regular rate for work over forty (40) hours per week. Sundays and Holidays shall be paid at double the straight time rate. All employees performing work on affected properties during or following emergencies shall receive the applicable rate of pay for the first sixteen (16) consecutive hours and all hours worked in excess of sixteen (16) consecutive hours shall be paid at double time until broken by an eight (8) hour rest period. Should an employee be called back to work within two hours of his normal quitting time, the previous hours worked shall count toward the above sixteen (16) hour provision.

**JACKSON COUNTY
HEAVY CONSTRUCTION - HOLIDAY SCHEDULE**

NO. 2: All work performed on New Year's Day, Decoration Day (Memorial Day), Independence Day (Fourth of July), Labor Day, Thanksgiving Day and Christmas Day, or days observed as such, and Sundays shall be paid at the rate of time and one-half (1½). Double (2) time shall be paid for work on Sundays or recognized holidays when and only if other craft employees of the same employer at work on that same job site are receiving double (2) time pay for that Sunday or holiday work. No work shall be performed on Labor Day, except in case of jeopardy of life or property. This rule is applied to protect Labor Day. When one of the above holidays falls on a Saturday, the preceding Friday shall be observed; when the holiday falls on a Sunday, the following Monday shall be observed. Where one of the specified holidays falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO. 17: All work performed on New Year's Day, Decoration Day (Memorial Day), Independence Day (Fourth of July), Labor Day, Thanksgiving Day, Christmas Day, or days observed as such, shall be paid at the rate of double (2) time. When a holiday falls on a Saturday, Friday shall be observed. When a holiday falls on a Sunday, Monday shall be observed. No work shall be performed on the Fourth of July or Labor Day except to save life or property. Where one of the holidays specified falls or is observed during the work week, then all work performed over and above thirty-two (32) hours in that week shall be paid at the rate of time and one-half (1½).

NO. 24: Work performed on New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day, or days celebrated as such, shall be paid at the double time rate of pay. If the holiday falls on Saturday, it will be observed on Friday; if the holiday falls on Sunday, it will be observed on Monday, and shall be paid for at double (2) the regular straight time rate of pay.

NO. 30: All work performed on New Year's Day, Decoration Day, Fourth of July, Labor Day, Christmas Day, Thanksgiving Day and Day after Thanksgiving or days celebrated for the same.



**DIVISION OF
LABOR
STANDARDS**

MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
**PREVAILING WAGE
PROJECT NOTIFICATION – CONTRACTOR INFORMATION**

The information below is requested pursuant to Sections 290.210 through 290.340 and 290.550 through 290.580, RSMo. During a time of excessive unemployment, only Missouri laborers and laborers from non-restrictive states shall be employed on public works projects. See 290.550 through 290.580, RSMo.

1. Date of Notification		2. Annual Wage Order Number Included in Bid Specifications	
3. Popular or Descriptive Name of Project			
4. Estimated Project Cost of Completion <i>(total construction contracts to be awarded)</i>		5. \$	
5. Exact Location of Project			
<u>County</u>	<u>City</u>	<u>Township</u>	
6. Official Name of Public Body or Agency			
7. Name of Contact Person			8. Phone Number <i>(include area code)</i>
9. Address			
10. E-mail Address		Website	
11. Anticipated Date for Soliciting or Advertising for Bids		12. Contract Award Date	
13. Estimated Start Date of Work	14. Estimated Date of Project Completion	15. Will There Be Any Federal Funds Used in this Contract? <input type="checkbox"/> Yes <input type="checkbox"/> No	
16. Contractor Information Notification			
General Contractor:			
Name		_____	
Address		_____	
City		State	ZIP
_____		_____	_____
Phone Number		E-mail Address	
_____		_____	
Type of Craftsmen Needed by Project _____			
Scope of Work _____			
List all Subcontractors:			
Name		_____	
Address		_____	
City		State	ZIP
_____		_____	_____
Phone Number		E-mail Address	
_____		_____	
Type of Craftsmen Needed by Project _____			
Scope of Work _____			
Name		_____	
Address		_____	
City		State	ZIP
_____		_____	_____
Phone Number		E-mail Address	
_____		_____	
Type of Craftsmen Needed by Project _____			
Scope of Work _____			

The state of Missouri requires workers on public works projects be paid the prevailing wage. Public bodies have duties as required under this law (Section 290.210 - 290.340, RSMo).

Mail, Fax or E-mail completed form to:

DIVISION OF LABOR STANDARDS

Attn: Prevailing Wage Section

P.O. Box 449 Jefferson City, MO 65102-0449

Phone: 573-751-3403

Fax: 573-751-3721

E-mail: prevailingwage@labor.mo.gov

Website: www.labor.mo.gov/DLS



**DIVISION OF
LABOR
STANDARDS**

MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
DIVISION OF LABOR STANDARDS

**AFFIDAVIT
COMPLIANCE WITH THE PREVAILING WAGE LAW**

I, _____, upon being duly sworn upon my oath state that: (1) I am the
(Name)
_____ of _____; (2) all requirements of
(Title) (Name of Company)
§§ 290.210 to 290.340, RSMo, pertaining to the payment of wages to workers employed on public works projects
have been fully satisfied with regard to this company's work on _____;

(Name of Project)

(3) I have reviewed and am familiar with the prevailing wage rules in 8 CSR 30-3.010 to 8 CSR 30-3.060; (4) based upon my knowledge of these rules, including the occupational titles set out in 8 CSR 30-3.060, I have completed full and accurate records clearly indicating (a) the names, occupations, and crafts of every worker employed by this company in connection with this project together with an accurate record of the number of hours worked by each worker and the actual wages paid for each class or type of work performed, (b) the payroll deductions that have been made for each worker, and (c) the amounts paid to provide fringe benefits, if any, for each worker; (5) the amounts paid to provide fringe benefits, if any, were irrevocably paid to a trustee or to a third party pursuant to a fund, plan, or program on behalf of the workers; (6) these payroll records are kept and have been provided for inspection to the authorized representative of the contracting public body and will be available, as often as may be necessary, to such body and the Missouri Department of Labor and Industrial Relations; (7) such records shall not be destroyed or removed from the state for one year following the completion of this company's work on this project; (8) when in effect, the requirements of §§ 290.550 through 290.580, RSMo, pertaining to excessive unemployment were fully satisfied; and (9) there has been no exception to the full and complete compliance with the provisions and requirements of Annual Wage Order No. _____ Section _____ issued by the Missouri Division of Labor Standards and applicable to this project located in _____ County, Missouri, and completed on the _____ day of _____, _____.

The matters stated herein are true to the best of my information, knowledge, and belief. I acknowledge that the falsification of any information set out above may subject me to criminal prosecution pursuant to §§290.340, 570.090, 575.040, 575.050, or 575.060, RSMo.

Signature

Subscribed and sworn to me this _____ day of _____, _____.
My commission expires _____, _____.

Notary Public

Receipt by Authorized Public Representative



**DIVISION OF
LABOR
STANDARDS**

MISSOURI DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS
DIVISION OF LABOR STANDARDS
REQUEST FOR WAGE DETERMINATION

PLEASE RETURN TO: Division of Labor Standards
Attn: Prevailing Wage Section
P.O. Box 449
Jefferson City, MO 65102-0449

Phone: 573-751-3403
Fax: 573-751-3721
E-mail: prevailingwage@labor.mo.gov
Website: www.labor.mo.gov/DLS

REQUESTER INFORMATION

I am requesting a wage determination according to Chapter 290 of the Missouri Prevailing Wage Law (sections 290.210 through 290.340 and 290.550 through 290.580 RSMo).

Name of Requester <i>(please print)</i>		Requester's Title	
Requester's Organization			Phone Number <i>(include Area Code)</i>
Mailing Address			E-mail Address
City	State	ZIP Code	

PUBLIC BODY INFORMATION

Contact Person at Public Body			
Official Name of the Public Body requesting the wage rates			Phone Number <i>(include Area Code)</i>
Street Address			E-mail Address
City	State	ZIP Code	

FUNDING INFORMATION

Will the federal government or any of its agencies furnish loans or grants for any part of the funds used in your contracts?
 Yes No

If "Yes," will the federal government or any of its agencies also prescribe a schedule of Prevailing Wage Rates?
 Yes No

COUNTY(IES) REQUESTED

Please list county(ies) requested: _____
(for St. Louis, please specify "County" or "City")

ANNUAL WAGE ORDER PASSWORDS

The Annual Wage Order is being provided to requesters via the Division's website. Passwords are required to access the Annual Wage Order and Incremental Increases on the Internet. Please provide an e-mail address below where we can send a password to you.

E-mail address: _____

Requester's Signature _____

_____/_____/_____
Date of Request

DOCUMENT 008400 - ATTACHMENTS

1.1 APPLICABLE AFFIDAVITS AND FORMS

- A. The electronic verification of work authorization, "E-Verify" form is bound hereinafter for Contractor's duplications and use.
- B. The OSHA "Affidavit of 10 Hour OSHA Training" is bound hereinafter for Contractor's duplication and use.
- C. "Contractor's Affidavit Concerning Drug/Alcohol Testing Program" form is bound hereinafter for Contractor's duplication and use.
- D. The "Missouri Service-Disabled Veteran Business Preference" form is bound hereinafter for Contractor's duplication and use.

END OF DOCUMENT 008400

FEDERAL WORK AUTHORIZATION PROGRAM AFFIDAVIT

I, _____, being of legal age and having been duly sworn upon my oath, state the following facts are true:

1. I am more than twenty-one years of age; and have first-hand knowledge of the matters set forth herein.
2. I am employed by _____ (hereinafter "Company") and have authority to issue this affidavit on its behalf.
3. Company is enrolled in and participating in the United States E-Verify (formerly known as "Basic Pilot") federal work authorization program with respect to Company's employees working in connection with the services Company is providing to, or will provide to, the District, to the extent allowed by E-Verify.
4. Company does not knowingly employ any person who is an unauthorized alien in connection with the services the Company is providing to, or will provide to, the District.

FURTHER AFFIANT SAYETH NOT.

By: _____ (individual signature)

For: _____ (company name)

Title: _____

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

NOTARY PUBLIC

My commission expires:

FEDERAL WORK AUTHORIZATION PROGRAM (“E-VERIFY”) ADDENDUM

Pursuant to Missouri Revised Statute 285.530, all business entities awarded any contract in excess of five thousand dollars (\$5,000) with a Missouri public school district must, as a condition to the award of any such contract, be enrolled and participate in a federal work authorization program with respect to the employees working in connection with the contracted services being provided, or to be provided, to the District (to the extent allowed by E-Verify). In addition, the business entity must affirm the same through sworn affidavit and provision of documentation. In addition, the business entity must sign an affidavit that it does not knowingly employ any person who is an unauthorized alien in connection with the services being provided, or to be provided, to the District.

Accordingly, your company:

- A. agrees to have an authorized person execute the attached “Federal Work Authorization Program Affidavit” attached hereto as Exhibit A and deliver the same to the District prior to or contemporaneously with the execution of its contract with the District;
- B. affirms it is enrolled in the “E-Verify” (formerly known as “Basic Pilot”) work authorization program of the United States, and are participating in E-Verify with respect to your employees working in connection with the services being provided (to the extent allowed by E-Verify), or to be provided, by your company to the District;
- C. affirms that it is not knowingly employing any person who is an unauthorized alien in connection with the services being provided, or to be provided, by your company to the District;
- D. affirms you will notify the District if you cease participation in E-Verify, or if there is any action, claim or complaint made against you alleging any violation of Missouri Revised Statute 285.530, or any regulations issued thereto;
- E. agrees to provide documentation of your participation in E-Verify to the District prior to or contemporaneously with the execution of its contract with the District (or at any time thereafter upon request by the District), by providing to the District an E-Verify screen print-out (or equivalent documentation) confirming your participation in E-Verify;
- F. agrees to comply with any state or federal regulations or rules that may be issued subsequent to this addendum that relate to Missouri Revised Statute 285.530; and
- G. agrees that any failure by your company to abide by the requirements a) through f) above will be considered a material breach of your contract with the District.

By: _____ (signature)

Printed Name and Title: _____

For and on behalf of: _____ (company name)

AFFIDAVIT OF 10 HOUR OSHA TRAINING

Comes now _____ as _____ first
Name Office Held

being duly sworn, on my oath, affirm _____ does
Company Name

comply with the requirements of Section 292.675, which requires all contractors and subcontractors doing work on the project to provide, and require its on-site employees to complete a ten-hour course in construction safety and health approved by the Occupational Safety and Health Administration (OSHA) or a similar program approved by the Missouri Department of Industrial Relations which is at least as stringent as an approve OSHA program.

In Affirmation thereof, the facts stated above are true and correct (The undersigned understands that false statements made in this filing are subject to the penalties provided under Section 292.675, RSMo).

Signature (person with authority)

Printed Name

Title

Date

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

Signature of notary

Date

Contractor's Affidavit Concerning Drug/Alcohol Testing Program

STATE OF MISSOURI)
) ss
COUNTY OF)

 COMES NOW the Affiant after having first been duly sworn and testifies as follows:

 My name is _____. I hold the principal office of _____
for _____. I, the undersigned, being duly sworn, certify that
_____ is in compliance with the provisions of Missouri Revised Statute §
161.371; that _____ has established and implemented a random drug and
alcohol testing program as required by Missouri Revised Statute § 161.371 and any applicable
regulations. I further certify that _____ shall subcontract work only to
subcontractors meeting the requirements of Missouri Revised Statute § 161.371.

Name of Contractor

Address

City

State

By:_____

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

Notary Public

My Commission Expires:

MISSOURI SERVICE-DISABLED VETERAN BUSINESS PREFERENCE

Pursuant to section 34.074, RSMo, a preference will be given all contracts for the performance of any job or service to service-disabled veteran business either doing business as Missouri firms, corporations, or individuals; or which maintain Missouri offices or places of business, when the quality of performance promised is equal or better and the price quoted is the same or less or whenever competing bids, in their entirety, are comparable.

Definitions:

Service-Disabled Veteran is defined as any individual who is disabled as certified by the appropriate federal agency responsible for the administration of veterans' affairs.

Service-Disabled Veteran Business is defined as a business concern:

- a. Not less than fifty-one (51) percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than fifty-one (51) percent of the stock of which is owned by one or more service-disabled veterans; and
- b. The management and daily business operations of which are controlled by one or more service-disabled veterans.

If a bidder meets the definitions of a service-disabled veteran and a service-disabled veteran business as defined in section 34.074, RSMo, and is either doing business as a Missouri firm, corporation, or individual; or maintains a Missouri office or place of business, the bidder **must** provide the following with the proposal in order to receive the Missouri service-disabled veteran business preference over a non-Missouri service-disabled veteran business when the quality of performance promised is equal or better and the price quoted is the same or less or whenever competing proposals, in their entirety, are comparable:

- a. A copy of a letter from the Department of Veterans Affairs (VA), or a copy of the bidder's discharge paper (DD Form 214, Certificate of Release or Discharge from Active Duty) from the branch of service the bidder was in; and
- b. A completed copy of this exhibit

(NOTE: For ease of evaluation, please attach copy of the above-referenced letter from the VA or a copy of the bidder's discharge paper to this Exhibit. The above-referenced letter from the VA and a copy of the bidder's discharge paper shall be considered confidential pursuant to subsection 14 of section 610.021, RSMo.)

By signing below, I certify that I meet the definitions of a service-disabled veteran and a service-disabled veteran business as defined in 34.074 RSMo and that I am either doing business as a Missouri firm, corporation, or individual; or maintain Missouri offices or places of business at the location(s) listed below.

Service-Disabled Veteran's Name
(Please Print)

Service Disabled Veteran Business Name

Service-Disabled Veteran's Signature

Missouri Address of Service-Disabled Veteran
Business

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Owner-furnished products.
 - 4. Access to site.
 - 5. Coordination with occupants.
 - 6. Work restrictions.
 - 7. Specification and drawing conventions.
 - 8. Miscellaneous provisions.

1.2 PROJECT INFORMATION

- A. Project Identification: **RAYTOWN HERNDON RESTAURANT**
 - 1. Project Location: 11501 East 350 Highway, Raytown, Missouri 64133.
- B. Owner: Raytown Quality Schools, 6608 Raytown Road, Raytown, MO. 64113.
 - 1. Owner's Representatives: Travis Hux and Josh Hustad.
- C. Architect: Hollis + Miller Architects, Inc., 1828 Walnut Street, Kansas City, MO. 64108.
 - 1. Architect's Representative: Sandy Cochran. Telephone 816-442-7700.
- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
 - 1. Refer to the Project Team Directory, Document 000101.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. All architectural, fire suppression, plumbing, mechanical, electrical, access control and utilities as indicated in the Contract Documents.
 - 2. Alternates: Refer to Section 012300.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract.

1.4 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will remove certain items from the Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.

1.5 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products:
 - 1. Refer to individual technical specifications, items include, but are not limited to:
 - a. Toilet and bath accessories in accordance with Section 102800.
 - b. Kitchen Appliances, Technology and AV Equipment.

1.6 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

- B. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine construction operations to Areas shown on Drawings.
 - 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Restrictions: Note that no deliveries to the Project Site will be allowed between the hours of 7:00 to 8:30 a.m. and 2:00 to 3:30 p.m.
 - b. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - c. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 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.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 4:00 p.m., Monday through Friday, unless otherwise indicated.
 - 1. Contractor shall have limited use of the building until school is out for the summer.
 - 2. Weekend Hours: Coordinate and schedule all weekend hours with the Owner not less than 48 hours in advance. Comply with regulations of authorities having jurisdiction.
 - 3. Early Morning Hours: Notify Owner of days when early morning hours will be required and comply with regulations of authorities having jurisdiction.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Architect and Owner not less than three days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Architect and Owner not less than three days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Buildings and Sites: Smoking is not permitted on School District property.
- F. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements for drug, alcohol and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

2. As a condition for the award of any service contract in excess of \$5,000.00 by the School District, the service provider must be enrolled in and currently participating in "E-Verify" or any other equivalent electronic verification of work authorization program operated by the U.S. Department of Homeland Security
3. As a further condition for the award of any service contract in excess of \$5,000.00 the service provider shall not knowingly employ any person who is an un-authorized alien in conjunction with the contracted services.
 - a. E-Verify forms are available for duplication and contractor's use in Section 008400 Attachments.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 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 scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
- C. Related Requirements:
 - 1. Section 014000 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.2 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect 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 Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.3 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.4 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.

1.5 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 LUMP-SUM AND UNIT-COST 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 (other than sales and use 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 ordered by Owner and/or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 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.

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

1. Allowance No. 1: Music and AV system. \$15,000.00

END OF SECTION 012100

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for "Substitutions for Convenience" and "Substitutions for Cause".
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for products selected under an allowance.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 3. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms. Substitutions for Cause, if any, shall be submitted after award of the contract as set forth hereinafter.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner. Substitutions for Convenience by the Contractor, shall be submitted prior to bidding as set forth hereinafter.
- B. Comparable Products: Naming of specified items on the Drawings and in the specifications, means that such named items are specifically required by the Architect and/or Owner. When the words "or comparable product" follows such named item(s), a substitution request must be submitted when proposing a product other than the named product. Requests for substitutions must be received by the Architect within the time frame set hereinafter.
- C. The following are not considered substitutions:
 - 1. Revisions to Contract Documents requested by the Owner or Architect.
 - 2. Specified options of products, materials and construction methods included in the Contract Documents.

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit at least one (1) paper copy or an electronic pdf copy of each request for consideration to the Architect. Clearly identify proposed product and all related options or fabrication or installation method to be replaced. Include Specification Section number and title, in addition to applicable Drawing numbers and titles.
 - 1. Substitution Request Form: Use facsimile of form provided at the end of this Section.
 - a. Accompanying each Substitution Request shall be a fully executed copy of the Substitution Request Form.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. A written and detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested of proposed substitution and of specified product shall be submitted for comparison and review by Architect.
 - f. Certificates and qualification data, where applicable or requested.

- g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. 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 date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Review Process: Submittal requests for proposed substitutions will be processed using the following procedures:
- a. Submittals will be "Received Dated" immediately upon arrival.
 - b. Submittals will be placed by receiving person in a file designated for that purpose.
 - c. Submittals will not be reviewed for completeness or compliance until after the date and time established for closing of receipt of substitution request submittals.
 - d. Submittals will be reviewed by a member of Hollis + Miller Architect's staff (or respective consultant). Reviewer(s) will not be designated until after closing period established for receipt of submittal of substitutions.
 - e. Reviewer's General Attitude will be:
 - 1) Burden of Proof is on Proposer.
 - 2) Reviewer should not be required to complete the submittal, that is, select from options or between models and lines of products.
 - 3) Reviewer should not be required to conduct an exhaustive review of the submittal. Submittals of manufacturer's catalogs which do not clearly indicate proposed product and proposed product options will be rejected.
 - 4) Reviewer should not be required to seek information from manufacturer's literature on file in the office, from an improperly submitted electronic submittal or information in other locations.
 - 5) Substitute must be "comparable to" or superior in those features and performance which the Project requires and those which the specified product will provide.
 - 6) Review is complete when, in the reviewer's opinion, significant deficiency(ies) are established. In such case, review of data covering other points of specifications is not required.
 - f. Reviewer will note action taken (No Exception taken to Submitted Manufacturer, No Exception taken to Specific Product, Exceptions Noted, Not Accepted or Received Late), the date, and his/her initials.
 - g. All submittals received after closing time will be "Received Dated", marked "Late", initialed by reviewer, and filed without review.
 - h. Submittals will be filed in Architect's office until completion of the Project.
4. Architect's Action:
- a. Architect will review requests for "Substitutions for Convenience" only once, no additional information may be submitted. Architect may request additional information as necessary for review of "Substitutions for Cause."
 - b. Architect will note action taken.
 - c. Architect is not obligated nor required to review any and all substitution requests.
 - d. Architect is not obligated to inform proposers of substitutions of incomplete and non-accepted requests for substitution.
 - e. Acceptance of Substitutions:
 - 1) Acceptance of Substitutions for Convenience: Accepted substitutions will be set forth in an Addendum and in no other manner.
 - a) Use product specified if Architect does not issue a decision on use of a proposed substitution.

- 2) Acceptance of Substitutions for Cause: Architect will review proposed substitution within 15 business days of receipt of request. If necessary, Architect will request additional information or documentation for evaluation within seven (7) business days of receipt of a request for Substitution for Cause.” Only acceptable substitutions will receive notification of status. Substitutions shall be considered unacceptable unless a form of acceptance is received by the Proposer.
 - a) Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b) Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 ELECTRONIC SUBMITTAL OF SUBSTITUTIONS

- A. Substitution Request submittals will be accepted for review when submitted electronically under the following conditions. Substitution requests which are not submitted in accordance with the criteria listed below may be rejected at the Architect’s discretion.
 1. Accompanying each submittal shall be a fully executed copy of the Substitution Request Form.
 2. Submittals sent to Hollis + Miller Architects, shall be sent to Christy Ostmeyer. Refer to Document 000101 - Project Team Directory, for mailing address and email address. Submittals directed to the attention of anyone other than the person named above will not be considered.
 3. Submittals of Substitutions for Cause must be received within the time limits set forth in Paragraph 2.1 A of this Section.
 4. Submittals of Substitutions for Convenience must be received prior to bidding and within the time limits set forth in Paragraph 2.1 B of this Section.
 5. Documentation requirements as set forth in 1.3 A.2a through 1.3 A.2m are applicable to electronic submittals.
 - a. Note: Electronic submittals in which the manufacturer’s entire catalog is submitted will be rejected.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 30 days prior to time required for preparation and review of related submittals.
 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Request is directly related to a “or comparable product” clause or similar language in the Contract Documents.
 - c. Specified product or method of construction cannot be provided within the Contract Time.
 - d. Specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
 - e. Specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution will provide the specified warranty.
 - f. Substitution request is fully documented and properly submitted.
 - g. Requested substitution will not adversely affect Contractor's construction schedule.
 - h. Requested substitution has received necessary approvals of authorities having jurisdiction.

- i. Requested substitution is compatible with other portions of the Work.
 - j. Requested substitution has been coordinated with other portions of the Work.
 - k. Requested substitution provides specified warranty.
 - l. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution only when submitted prior to bidding, and no later than noon on **March 21, 2019**. Requests received after that time may be considered or rejected at discretion of Architect.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- C. The Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptance or validate request for substitution, nor does it constitute approval.
- D. Under no circumstances does the Architect's and/or Owner's acceptance of any such substitution relieve the Contractor from timely, full and proper performance of the Work.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SUBSTITUTION REQUEST FORM

MAIL TO: Hollis + Miller Architects
1828 Walnut St., Suite 922
Kansas City, MO. 64108

PROJECT: Raytown Quality Schools
Raytown Herndon Restaurant
Project No. 17048

SPECIFIED ITEM: _____

PROPOSED SUBSTITUTE: _____

SUBMITTED BY:

Firm: _____

Address: _____

Signature: _____

Date: _____ Phone No. _____ Fax No. _____

Attach complete description, designation, catalog or model number, Spec Data Sheet and other Technical Data and samples, including Laboratory Tests if Applicable.

Fill in blanks below:

1. Will substitution affect dimension indicated on drawings? _____

2. Will substitution affect wiring, piping, ductwork, etc., indicated on drawings? _____

3. What effect will substitution have on other trades? _____

4. Differences between proposed substitution and specified item? _____

5. Any and all impacts on costs, design modifications, additional architectural and engineering services, material and labor changes, schedule changes, and other unanticipated consequences, resulting from this substitution in lieu of the specified item, shall be the full responsibility of the contractor and his subcontractors and supplier.
6. Manufacturer's warranties of the specified items and proposed items are: [] same [] different, *explain:*

REVIEW COMMENTS:

- [] **No Exception taken to Submitted Manufacturer**
Manufacturer only is accepted due to time limitations for full review of product, or because no specific product data is submitted, or other unspecified reasons. Contractor must still bear full responsibility for compliance with contract requirements.
- [] **No Exception taken to Specific Products**
- [] **Exceptions Noted**
See attached copy or notes on product literature
- [] **Not Accepted**
- [] **Received too Late**

By: _____ Date: _____

Remarks: _____

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions for "cause" made after the Contract award.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 14 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.
 - 1. Change Orders are to be dated and numbered sequentially.
- B. Change Orders will describe the change or changes, will refer to the related Proposal Request number and date; and will be signed by the Owner and Architect.
- C. Changes in the Project (additions and credits) where unit prices are not required by the bid documents and value of changes or extra work is determined by an estimate and accepted in a lump sum amount, by cost and percentages, or by cost and a fixed fee, the percentages for overhead and profit, or commission to be allowed for net increases shall in no case exceed the following:
 - 1. To Contractor for work performed by his own forces 10%
 - 2. To Contractor for work performed by other than his own forces 5%
 - 3. To Subcontractor for work performed by his own forces 10%
 - 4. To Subcontractor for work performed by other than his own forces 5%

Percentages for overhead and profit will not be allowed on bond premiums.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 012300 "Alternates" for procedural requirements governing the handling and processing of allowances.
 - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work at each of the individual schools and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date, but no later than fourteen (14) days after Notice of Award.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.

- 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five (5) percent of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five (5) percent of the Contract Sum and subcontract amount.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 1st of the month. The period covered by each Application for Payment is one month, ending on the 25th day of the month.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment. Sample copies are included in Project Manual.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:

- a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit one (1) signed and notarized electronic copy of each Application for Payment to Architect. One copy shall include waivers of lien and similar attachments if required.
- 1. With each application for payment, include a transmittal form listing attachments and recording appropriate information about application.
- H. Partial Lien Waivers (Waivers of Mechanic's Lien): Starting with Application for Payment No. 2, submit waivers of mechanic's liens from each subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
- 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 - 5. Waiver Forms: Submit executed waivers of lien on forms, included in the Project Manual.
- I. 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. Products list (preliminary if not final).
 - 5. Schedule of unit prices.
 - 6. Submittal schedule (preliminary if not final).
 - 7. List of Contractor's staff assignments.
 - 8. List of Contractor's principal consultants.
 - 9. Copies of building permits.
 - 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 11. Initial progress report.
 - 12. Report of preconstruction conference.
 - 13. One (1) electronic copy of all Contractor and Subcontractor Certified Payroll Reports.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
- 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
- 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 6. AIA Document G707, "Consent of Surety to Final Payment."
 - 7. Copy of the Affidavit of Compliance with Prevailing Wage Determination sent to the State.
 - 8. Asbestos-Free and Lead-Free Certification Letter in form acceptable to Owner.
 - 9. Evidence that claims have been settled.
 - 10. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

11. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

Application and Certificate for Payment

TO OWNER: Raytown Quality Schools
6608 Raytown Road
Raytown, MO 64133

PROJECT: 17047.00 Raytown HS and Raytown
South HS Baseball Stadium
Improvements
Raytown High School
6019 Blue Ridge Blvd.
Raytown South High School
8211 Sterling Ave.
Raytown, Missouri 64138

APPLICATION NO: 001
PERIOD TO:

Distribution to:
OWNER: ARCHITECT:
CONTRACTOR: FIELD:
OTHER:

FROM CONTRACTOR: Hollis + Miller Architects
1828 Walnut Street
Suite 922
Kansas City, Missouri 64108

VIA ARCHITECT: CONTRACT FOR: General Construction
CONTRACT DATE: / /
PROJECT NOS: / /

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)	\$0.00

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.

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

DRAFT

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: As soon as practical after award of Contract, but not later than fifteen (15) days, 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 Use form acceptable to Architect. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within fifteen (15) days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 - a.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
 3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in Revit version 17 using Windows 10 operating system.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.6 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.

- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven (7) working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFI shall not indicate approval of a change to the Contract Time or the Contract Sum.
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
 - b. Change Proposals shall be made according to Section 012600 "Contract Modification Procedures."
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly in form acceptable to Architect. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven (7) days if Contractor disagrees with response.
1. Change in Work shall be recorded to the Project Record set per Section 017839 "Project Record Documents."

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three (3) days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.

- l. Preparation of record documents.
 - m. Use of the premises and existing building.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for moisture and mold control.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 21 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Installation of Owner's furniture, fixtures, and equipment.
 - k. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly or biweekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access and work hours.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

- F. Coordination Meetings: Conduct project coordination meetings at intervals necessary for coordination of the Project. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access and work hours.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. 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. Construction schedule updating reports.
 - 3. Weekly construction progress reports.
 - 4. Material location reports.
 - 5. Site condition reports.
 - 6. Special reports.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
 - 2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
- B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- C. Construction Schedule Updating Reports: Submit every two weeks. Coordinate one of the updating reports with Application for Payment.
- D. Daily Construction Reports: Submit at weekly intervals, prior to next meeting.
- E. Material Location Reports: Submit at weekly intervals.
- F. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including work stages, area separations and interim milestones.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review submittal requirements and procedures.
 - 6. Review time required for review of submittals and resubmittals.
 - 7. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 8. Review time required for Project closeout and Owner startup procedures.
 - 9. Review and finalize list of construction activities to be included in schedule.

10. Review procedures for updating schedule.

1.5 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed 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.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than seven (7) days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 14 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 14 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Use of premises restrictions.
 - e. Provisions for future construction.
 - f. Seasonal variations.
 - g. Environmental control.
 6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.

- j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
- a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.

- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
- 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and Contract Time.
- G. Recovery Schedule: When periodic update indicates the Work is 7 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within fourteen (14) days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.3 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
- 1. Name of Project.
 - 2. Name of Contractor.
 - 3. Date of report.
 - 4. Outline of current week's construction activities.
 - 5. Outline of anticipated (look ahead) activities for subsequent week.
 - 6. Critical path items for current and subsequent week.
 - 7. List of subcontractors at Project site.
 - 8. Approximate count of personnel at Project site.
 - 9. Equipment at Project site.
 - 10. Material deliveries.
 - 11. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 12. Accidents.
 - 13. Meetings and significant decisions.

14. Unusual events (see special reports).
15. Stoppages, delays, shortages, and losses.
16. Meter readings and similar recordings.
17. Emergency procedures.
18. Orders and requests of authorities having jurisdiction.
19. Change Orders received and implemented.
20. Construction Change Directives received and implemented.
21. Services connected and disconnected.
22. Equipment or system tests and startups.
23. Partial completions and occupancies.
24. Substantial Completions authorized.

- B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner and Architect, within two (2) day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Failure to submit reports can be cause for delay in progress payments by the Owner until reports are made current.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule three days before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - 3. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor, at a nominal cost, for use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
 - b. Digital Drawing Software Program: The Contract Drawings are available in Revit version 17 using Windows 10 operating system.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.

- B. General:
 1. Submittals shall be neat and legible, of uniform scale matching contract Documents, with all sheets of similar information of same size.
 2. Electronic copies of CAD Drawings of the Contract Drawings may be provided by Architect for Contractor, at a nominal cost, subject to the requirements of Section 017839 "Project Record Documents."

- C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of 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.

- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. It is expected that all submittals will be submitted within the durations outlined in the bid form as provided by each trade.
 - a. The completion time of the contract will not be extended for delays caused by tardiness of submittals. Cost of such delays shall not be borne by the Owner and may be back-charged as necessary.
 - 1) Contractor shall assume full responsibility for providing materials as specified at their risk to maintain schedule if submittals are not submitted within durations provided on the bid form.
 - b. Upon receipt of unapproved submittals, Contractors will have seven (7) calendar days to revise and resubmit.
 2. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 3. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 4. Resubmittal Review: Allow five (5) working days for review of each resubmittal.
 5. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 days for initial review of each submittal.
 6. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

- E. Electronic Submittals: Identify and incorporate information in each electronic (pdf) submittal file as follows:
 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., RQS-079200.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., RQS-079200.01.A).
 - b. Specific material/product identifier: After listing the project identifier and section number as described above, clearly indicate the material/product submitted corresponding to specific paragraph in the specification (e.g., Silicone Joint Sealant – 2.2 A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.

4. Transmittal Form for Electronic Submittals: Use electronic (pdfs) form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Names of subcontractor, manufacturer, and supplier.
 - g. Category and type of submittal.
 - h. Submittal purpose and description.
 - i. Specification Section number and title.
 - j. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - n. Indication of full or partial submittal.
 - o. Transmittal number, numbered consecutively.
 - p. Submittal and transmittal distribution record.
 - q. Other necessary identification.
 - r. Remarks.
 5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal and noting on attached separate sheet, prepared on Contractor's letterhead.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. 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: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Post electronic submittals as PDF electronic files directly to Architect, refer to Project Team Directory.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - b. Along with the electronic submittal, Contractor shall submit to the Architect, one (1) full sized hard copy of each shop drawing for review and approval, as deemed necessary by the Architect.

- c. Along with the electronic submittal, contractors shall submit to the Architect, one (1) color deck or color card for each submittal requiring color selection for review, approval and color selection, as deemed necessary by the Architect.
 - 3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to clearly show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before or concurrent with Samples and Shop Drawings, as applicable.
 - 6. Submit Product Data in the following format:
 - a. PDF electronic file according to Paragraph 2.1.A.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 - 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file according to Paragraph 2.1.A.
- 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 applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 - 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples 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. Samples for "initial selection" shall be listed as a separate item in the submittal schedule.
 - b. Number of Samples: Unless specifically required otherwise in Specification Section, 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.
 6. 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 one (1) set of Samples to Architect for review. Owner shall reserve the right to request up to three (3) total sets of Samples for review and records.
 - 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 one (1) set of paired units that show approximate limits of variations.
 7. Electronic Transmittal: Provide PDF transmittal for all physical Samples. Include digital image file illustrating Sample characteristics, and identification information for record.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 1. Name of evaluation organization.
 2. Date of evaluation.
 3. Time period when report is in effect.
 4. Product and manufacturers' names.
 5. Description of product.
 6. Test procedures and results.
 7. Limitations of use.
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. 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 the Contractor's approval stamp and will return them without action.
- B. Action Submittals: Contractor is responsible for conforming and correlating dimensions at job sites for tolerances, clearances, quantities, fabrication processes, coordination of the Work with multiple trades, and full compliance with the Contract Documents. The Architect will review submittals for general conformance with the Contract Documents. Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 - 1. No Exception Taken: Signifies item represented in the submittal conforms with the design intent, complies with the intent of the Contract Documents and is acceptable for incorporation into the Work. Contractor is to proceed with fabrication or procurement and related work.
 - 2. Exceptions Noted: Signifies item represented in the submittal conforms with the design concept, complies with the intent of the Contract Documents and is recommended for incorporation into the Work in accordance with the Architect's and/or Consultant's notations. Contractor is to proceed with the work in accordance the Architect's and/or Consultant's notations marked on the returned submittal or letter of transmittal. Resubmittal is not required.
 - 3. Revised and Resubmit: Signifies item represented in the submittal appears to conform with the design concept and comply with the intent of the Contract Documents, but information is either insufficient or contains discrepancies which prevent the Architect and/or his Consultant from completing his review. Contractor is to resubmit revised information. Fabrication or procurement of the item and related work is not to proceed until the submittal is acceptable.
 - 4. Not Accepted: Signifies item represented in the submittal does not conform with the design concept or comply with the intent of the Contract Documents and is not recommended for incorporation into the Work. Contractor shall submit items responsive to the Contract Documents.
- 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 prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -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.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups/Field Samples: Full-size physical assemblies that are constructed on-site. Mockups/field samples are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups/Field Samples are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 2. Integrated Field Samples: Field samples of select portions exterior envelope or interior construction erected as part of the Work. Field samples may consist of multiple products, assemblies, and subassemblies.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

- J. Experienced: When used with an entity or individual, "experienced" means, unless otherwise specified in the individual specification section, having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. Whenever Contract Documents reasonably infer materials or installation as necessary to produce the intended results, but do not fully detail or specify such materials, the Contractor shall provide the more expensive method or material, or greater quantity, unless he has obtained a written decision from the Architect.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For field samples mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 1. Indicate manufacturer and model number of individual components.
 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five (5) days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at 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.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement that equipment complies with requirements.

3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.

- d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
2. 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.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
- 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven (7) days for initial review and each re-review of each mockup.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Unless otherwise indicated in the Contract Documents, demolish and remove mockups when directed unless otherwise indicated.
- L. Field Samples: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.9 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. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
- 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. 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 or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.

11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).

73. ECIA - Electronic Components Industry Association; www.eciaonline.org.
74. EIA - Electronic Industries Alliance; (See TIA).
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
83. FM Approvals - FM Approvals LLC; www.fmglobal.com.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
85. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
86. FSA - Fluid Sealing Association; www.fluidsealing.com.
87. FSC - Forest Stewardship Council U.S.; www.fscus.org.
88. GA - Gypsum Association; www.gypsum.org.
89. GANA - Glass Association of North America; www.glasswebsite.com.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
94. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
95. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
96. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
100. ICC - International Code Council; www.iccsafe.org.
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
104. IEC - International Electrotechnical Commission; www.iec.ch.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
109. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
110. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
111. ILI - Indiana Limestone Institute of America, Inc.; www.ili.ai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
116. ISO - International Organization for Standardization; www.iso.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
119. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
120. LMA - Laminating Materials Association; (See CPA).
121. LPI - Lightning Protection Institute; www.lightning.org.
122. MBMA - Metal Building Manufacturers Association; www.mbma.com.
123. MCA - Metal Construction Association; www.metalconstruction.org.
124. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
125. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
126. MHIA - Material Handling Industry of America; www.mhia.org.
127. MIA - Marble Institute of America; www.marble-institute.com.
128. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
129. MPI - Master Painters Institute; www.paintinfo.com.
130. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
131. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.

133. NADCA - National Air Duct Cleaners Association; www.nadca.com.
134. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
135. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
136. NBI - New Buildings Institute; www.newbuildings.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
138. NCMA - National Concrete Masonry Association; www.ncma.org.
139. NEBB - National Environmental Balancing Bureau; www.nebb.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
141. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
142. NEMA - National Electrical Manufacturers Association; www.nema.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
145. NFPA - National Fire Protection Association; www.nfpa.org.
146. NFPA - NFPA International; (See NFPA).
147. NFRC - National Fenestration Rating Council; www.nfrc.org.
148. NHLA - National Hardwood Lumber Association; www.nhla.com.
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
151. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
152. NRCA - National Roofing Contractors Association; www.nrca.net.
153. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
154. NSF - NSF International; www.nsf.org.
155. NSPE - National Society of Professional Engineers; www.nspe.org.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
157. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
158. NWFA - National Wood Flooring Association; www.nwfa.org.
159. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
160. PDI - Plumbing & Drainage Institute; www.pdionline.org.
161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
162. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
163. RFCI - Resilient Floor Covering Institute; www.rfci.com.
164. RIS - Redwood Inspection Service; www.redwoodinspection.com.
165. SAE - SAE International; www.sae.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
167. SDI - Steel Deck Institute; www.sdi.org.
168. SDI - Steel Door Institute; www.steeldoor.org.
169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
171. SIA - Security Industry Association; www.siaonline.org.
172. SJI - Steel Joist Institute; www.steeljoist.org.
173. SMA - Screen Manufacturers Association; www.smainfo.org.
174. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
177. SPIB - Southern Pine Inspection Bureau; www.spib.org.
178. SPRI - Single Ply Roofing Industry; www.spri.org.
179. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
180. SSINA - Specialty Steel Industry of North America; www.ssina.com.
181. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
182. STI - Steel Tank Institute; www.steel tank.com.
183. SWI - Steel Window Institute; www.steelwindows.com.
184. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
186. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
187. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
190. TMS - The Masonry Society; www.masonrysociety.org.
191. TPI - Truss Plate Institute; www.tpinst.org.
192. TPI - Turfgrass Producers International; www.turfgrasssod.org.
193. TRI - Tile Roofing Institute; www.tilerroofing.org.
194. UL - Underwriters Laboratories Inc.; www.ul.com.

195. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
 196. USAV - USA Volleyball; www.usavolleyball.org.
 197. USGBC - U.S. Green Building Council; www.usgbc.org.
 198. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
 199. WASTEC - Waste Equipment Technology Association; www.wastec.org.
 200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
 201. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
 202. WDMA - Window & Door Manufacturers Association; www.wdma.com.
 203. WI - Woodwork Institute; www.wicnet.org.
 204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
 205. WWPA - Western Wood Products Association; www.wwpa.org.
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 3. ICC - International Code Council; www.iccsafe.org.
 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservation.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014529 – TESTING AND INSPECTIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The preceding “General Conditions” are a part of these specifications and the Contractor shall consult them in detail in connection with this part of the work.

1.2 SCOPE OF WORK

- A. Employment of a testing and inspection firm acceptable to the Owner. Approximate scope of testing and inspection shall be as indicated on the drawings and herein specified in the sections of the specifications.

1.3 TESTING AND INSPECTION CHARGES

- A. For the following conditions, costs of testing and inspection services shall be paid for by the Contractor, apart from the Testing and Inspection.
 1. Costs arising from errors or omissions by the Contractor.
 2. Costs of concrete cores, of re-testing materials that fail, and of required identification of materials (mill tests, manufacturers certifications, etc.).
 3. Costs of test and inspections required to expedite the Contractors operations.

1.4 CONCRETE WORK

- A. Reinforcement shall be positively identified by heat numbers and mill analysis. Otherwise, Contractor shall provide test by qualified laboratory, one test for each 5 tons or fraction thereof, each size and type of reinforcing steel. Cement shall be from tested bins and properly identified at the mixing plant. Contractor shall provide to the testing laboratory, aggregate samples for approval. Testing laboratory shall prepare 3 concrete cylinders for each 25 cubic yards, or fraction thereof placed – 2 cylinders to be tested at 7 days, and 1 cylinder at 28 days. Follow ASTM standards throughout.

1.5 GENERAL TESTS AND INSPECTIONS

- A. Observe all building code test and inspection requirements. Notify proper State, County and City authorities, for their required inspections.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 014529

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
 - 1. Water service is available at each school.
 - 2. No "bulk" water will be provided. Contractor shall provide and pay for his/her own bulk water.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
 - 1. Contractor shall make his/her own provisions for and pay for power used for on-site welding.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- C. 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, 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.
- D. 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.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide the following:
 - 1. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide bases for supporting posts.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- C. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: A temporary field office is not required.
- B. 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. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".

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.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial 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. 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.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
 - 1. Provide electric distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 - 2. Install lighting for Project identification sign.
- I. Telephone Service: Superintendent shall be available via cellular telephone from the hours of 7:00 a.m. to 5:00 p.m.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide portable storage containers as required. Containers may be located on School District property located as approved by the Owner. Storage containers shall be noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Temporary Use of Existing Roads and Paved Areas: Use of existing paved areas shall be coordinated and scheduled with the Owner. Limit use of paved areas to those areas adjacent to areas of work indicated on the Drawings.
 - 1. Use of existing roads and paved areas shall be acceptable if traffic is coordinated and does not damage existing roads and paved areas.
 - 2. Contractor shall repair any damage to finished surfaces of roads and paved areas, including sidewalks, to the satisfaction of the Owner. Repair work, if any, must be completed just prior to date established for Substantial Completion.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- F. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- G. 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.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Enclosure Fence: Before construction operations begin, furnish and install staging area enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 - 1. Extent of Fence: As indicated on Drawings.
- D. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- F. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- G. 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.

- H. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise as deemed necessary by Architect.
 - 1. Construct dustproof partitions with Type X gypsum wallboard with joints taped on occupied side or fire-retardant treated plywood on occupied side, and 6 mil polyethylene on construction operations side.
 - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 3. Insulate partitions to control noise transmission to occupied areas.
 - 4. Provide foam gasketing, attached to framing and not to construction to remain, to seal joints and perimeter of temporary partition. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 5. Protect air-handling equipment.
 - 6. Provide walk-off mats at each entrance through temporary partition.

- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 1. Use permanent HVAC system to control humidity.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for products selected under an allowance.
 - 2. Section 012200 "Unit Prices" for products selected under a unit price.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 5. Section 014200 "References" for applicable industry standards for products specified.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architects Action: For comparable products submitted for "Cause", if necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within fifteen (15) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later. For comparable products submitted for "Contractor's Convenience", Contractor must submit all information necessary to make a direct comparison to specified product for Architect's review, no additional information may be submitted.
 - a. Form of Approval: As specified in Section 012500 "Substitution Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered prior to bidding only.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
2. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered prior to bidding only.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Cutting and patching.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.

- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures."
 - 3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 4. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.3 INFORMATIONAL SUBMITTALS

- A. Certificates: Contractor shall certify that location and elevation of improvements comply with requirements.

- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 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 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions 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. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize /prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."
- 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.

3.6 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- 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: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition waste.
 - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- E. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- B. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.4 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Store items in a secure area until delivery to Owner.
 - 3. Transport items to Owner's storage area designated by Owner.
- C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- E. Plumbing Fixtures: Separate by type and size.
- F. Lighting Fixtures: Separate lamps by type and protect from breakage.
- G. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for progress cleaning of Project site.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 4. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
 - 5. Submit test/adjust/balance records.

6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 2. Complete startup and testing of systems and equipment.
 3. Perform preventive maintenance on equipment used prior to Substantial Completion.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 5. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 6. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 7. Complete final cleaning requirements, including touchup painting.
 8. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. 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.

1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.
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.

4. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect will return annotated file.

1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: 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, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 1. General: Provide one (1) electronic copy of warranties.
 2. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. 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.
 - e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - f. Sweep concrete floors broom clean in unoccupied spaces.
 - g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - i. Remove labels that are not permanent.
 - j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - k. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

- I. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - m. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - n. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - o. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least fourteen (14) days before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within ten (10) days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - 1. List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. General: Submit one (1) copy in pdf electronic file format.
- B. 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.
- C. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- E. 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.
- F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.

- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.

- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

- D. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.

- B. Descriptions: Include the following:
 1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.

- C. Operating Procedures: Include the following, as applicable:
 1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.

- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 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.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.

- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 1. Do not use original project record documents as part of operation and maintenance manuals.
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

- A. General: Final Payment will not be made until Project Record Documents are submitted to, reviewed by and are acceptable to the Architect.
- B. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record prints.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned and marked-up record prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.
- C. Record Specifications: Comply with the following:
 - a. Initial Submittal:
 - 1) Submit one paper-copy set(s) of marked-up record specifications.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned and marked-up record specifications.
- D. Record Product Data: Submit one (1) paper copy of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- E. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- F. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one (1) set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013300 "Submittal Procedures" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Refer to previous Article.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Refer to previous Article.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

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.
- B. Format: Refer to previous Article.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
 - 3. Pre-Produced demonstration and training videos.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.3 CLOSEOUT SUBMITTALS

- A. Pre-Produced Demonstration and Training Video Recordings: Submit two (2) copies within seven-days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name of Architect.
 - c. Name of Contractor.
 - 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 - 3. At completion of training, submit complete training manual(s) for Owner's use. One copy shall be, in PDF electronic file format on compact disc.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 - 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 - 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.

7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Coordinate with Owner for number of participants, instruction times and location.
 2. Describe system design, operational requirements, criteria and regulatory requirements.
 3. Owner will furnish Contractor with names and positions of participants.
 - a. Owner will have in attendance a participant to describe Owner's operational philosophy.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner, through Architect, with at least seven (7) days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. Preproduced Video Recordings: Video recordings may be used as a component of each training module. Upon completion of training, furnish to Owner one (1) copy of each video used for training.

END OF SECTION 017900

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of buildings and site improvements.
 - 2. Removing below-grade construction.
 - 3. Disconnecting, capping or sealing, and site utilities.
 - 4. Salvaging items for reuse by Owner.

- B. Related Requirements:
 - 1. Section 011000 "Summary" for use of the premises and phasing requirements.
 - 2. Section 013200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
 - 3. Section 024119 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.
 - 4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse if indicated in walkthrough. Include fasteners or brackets needed for reattachment elsewhere.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
 - 1. Owner will retain "first right of refusal" for all items to be demolished.

- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for noise control and dust control.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.

- B. Engineering Survey: Submit engineering survey of condition of building.

- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.
- D. Schedule of Building Demolition Activities: Indicate the following:
1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 2. Temporary interruption of utility services.
 3. Shutoff and capping or re-routing of utility services.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
1. Before building demolition, Owner will remove the following items as designated on a walk through prior to demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
 2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Hazardous Materials: Present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
 3. Owner will provide material safety data sheets for materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.
- F. On-site storage or sale of removed items or materials is not permitted.

1.9 COORDINATION

- A. Arrange demolition schedule so as not to interfere with [Owner's on-site operations] [or] [operations of adjacent occupied buildings].

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

- A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. 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. Comply with Section 013233 "Photographic Documentation."

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.
- B. Salvaged Items: Comply with the following:
 1. Clean salvaged items of dirt and demolition debris.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to storage area designated by Owner.
 5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.
 1. Owner will arrange to shut off utilities when requested by Contractor.
 2. Arrange to shut off utilities with utility companies.
 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction. Future work may or may not require re-connection and work performed under this scope shall accommodate both requirements.

5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of demolition.
- C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.
 1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."
 1. Protect adjacent buildings and facilities from damage due to demolition activities.
 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
 4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 2. Maintain fire watch during and for at least 24 hours after flame-cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY EXPLOSIVES

- A. Comply with recommendation in specialty explosives consultant's report.

3.7 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
- C. Salvage: Items to be removed and salvaged are indicated on Drawings.
- D. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.
- E. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
 - 1. Remove below-grade construction, including basements, foundation walls, and footings, completely to depths indicated.
- F. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
- G. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

3.8 SITE RESTORATION

- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
- B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 312000 "Earth Moving."
- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.9 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.10 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Do not burn demolished materials.

3.11 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
 - 1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Foundation walls and stem walls.
 - 2. Slabs-on-grade.
 - 3. Concrete between roof curbs at roof-top air handling units.

- B. This Section also includes the following:
 - 1. Providing the granular drainage fill/capillary break fill course beneath building floor slabs on grade.
 - 2. Providing foundation insulation.

- C. Related Requirements:
 - 1. Section 012100 "Allowances" for those allowances affecting work of this Section.
 - 2. Section 012200 "Unit Prices" for unit prices affecting work of this Section.
 - 3. Section 012300 "Alternates" for those alternates related to work of this Section.
 - 4. Section 033523 "Decorative Polished Concrete Finishes" for applications of polished concrete finishes and protection of slab surfaces prior to polishing.
 - 5. Section 321313 "Concrete Paving" for concrete pavement and walks.
 - 6. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Architect and Engineer.
 - b. Contractor's superintendent.
 - c. Independent testing agency responsible for concrete design mixtures.
 - d. Owner's testing agency.
 - e. Ready-mix concrete manufacturer.
 - f. Concrete Subcontractor.
 - g. Special concrete finish Subcontractor.
 - h. Manufacturer's representative for waterproofing admixture.
 - i. Concrete polishing subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, perimeter insulation installation, requirements for slabs to receive polished concrete finish, waterproofing admixture, concrete repair procedures, and concrete protection.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
 - a. Batch delivery tickets shall indicate batch weights as well as amount of available water to add on each delivery ticket.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Architect.
- E. Samples: For each of the following materials:
 - 1. Form-facing panels.
 - 2. Form ties.
 - 3. Form liners.
 - 4. Exposed aggregates.
 - 5. Chamfers and rustications.
 - 6. Waterstops.
 - 7. Vapor retarder.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Steel reinforcement and accessories.
 - 4. Curing compounds.
- D. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.
- F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, [acceptable to authorities having jurisdiction,] qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Sample Panels: After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, cast vertically, approximately 48 by 48 by 6 inches minimum, to demonstrate the expected range of finish, color, and texture variations.
1. Locate panels as indicated or, if not indicated, as directed by Architect.
 2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.
 3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
 4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
 5. Demolish and remove field sample panels when directed.
- E. Mockup for Slabs-on-Grade to receive Polished Concrete and Stained Concrete Finish: Cast concrete slab-on-grade to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship. Concrete shall be of same mix design to be used for slabs on grade.
1. For each type of grind and finish level, pour and finish a separate slab-on-grade to be used for a field sample of the polished concrete.
 2. Build panel not less than 100 sq. ft. (10 by 10 feet) for formed surface in the location indicated or, if not indicated, as directed by Architect.
 3. Cut contraction/control joints at thirds points each way.
 4. Demolish and legally dispose of mockup after date established for Substantial Completion.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Protect foam plastic insulation as follows:
1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site before installation time.
 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- C. Protection of Slabs to receive Polished Concrete Finishes: Refer to Section 033523 "Decorative Polished Concrete Finishes."

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301.
 2. ACI 303.1
 3. ACI 117.
 4. ACI 318.
 5. ACI 360.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that 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. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum; non-staining; in longest practicable lengths.
- B. Rustication Strips (033000.A05): Wood, metal, PVC, or rubber strips, kerfed for ease of form removal; nonstaining; fabricated to configurations indicated, in longest practicable lengths.
- C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Slab –on-grade supports: Provide supports specifically designed for bearing on soil.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C 150/C 150M, Type I and Type III, gray.
 - a. Provide white at concrete mixes indicated to receive colored pigments.
 - 2. Fly Ash: ASTM C 618, Class F or C].
 - a. Fly ash may not be used for concrete slabs on grade and elevated concrete slabs indicated to receive a polished concrete finish.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size:
 - a. 1-inch nominal for slabs on grade.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- G. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Davis Colors
 - b. QC Construction Products
 - c. Scofield, L.M. Company
 - d. Solomon Colors, Inc.
 - 2. Color: As selected by Architect from manufacturer's full range.
- H. Water: ASTM C 1602/C 1602M and potable.
- I. Waterproofing (Capillary Break) Admixture: Admixture shall be formulated to react with water and alkali in the concrete to fill the capillaries within the concrete with calcium silicate hydrate. Admixture shall also have plasticizing properties. Admixture shall be used in lieu of a portion of the mix water, not in addition to the mix water.
 - 1. Manufacturer's Warranty: Submit manufacturer's standard warranty executed by an authorized company official. Manufacturer's warranty is in addition to, and not a limitation of other rights Owner may have under provisions of the Contract Documents.
 - a. Warranty Period: Ten (10) years commencing on the date of acceptance of the Project by Owner or date of Substantial Completion, whichever is earliest.

- b. Warranty Terms: Terms to include moisture related failures, including all finish floor materials and labor.
- 2. Admixture Manufacturers and Products:
 - a. Concrete Earth; Inpervius.
 - b. Concure Systems; Concure.
 - c. ISE Logik Industries; MVRA 900.
 - d. Specialty Products Group (SPG); VaporLock 20/20.
 - e. Barrier One International; Barrier One.
- 3. Accessories materials:
 - a. Topical vapor sealer as necessary when results from moisture testing by waterproofing admixture manufacturer indicate moisture vapor emission and/or relative humidity with slab exceeding acceptable levels.
- 4. Locations to receive Waterproofing Admixture:
 - a. New slabs-on-grade.
 - b. Use of waterproofing admixtures at polished concrete shall be coordinated with concrete polisher prior to installation.

2.6 WATERSTOPS

- A. Non-Swelling, Pre-formed Waterstops (033000.A13): Manufactured rectangular pre-formed joint sealant strip for watertight bond to fresh and cured concrete surfaces. Material shall be a self-sealing adhesive compound with a square or rectangular cross-section. Waterstop shall bond to cured concrete surfaces and shall fuse with fresh concrete. Resistance to hydrostatic head shall not be less than 60 feet of water (non-moving joints).
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Henry Company "SF302 Synko-Flex, or comparable product from one of the following:
 - a. Carlisle Coatings & Waterproofing, Inc.
 - b. CETCO.
 - c. Concrete Sealants Inc.
- B. Flexible Rubber Waterstops: CE CRD-C 513 for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
 - 1. Profile: Flat dumbbell with or without center bulb.
 - 2. Dimensions: 6 inches by 3/8 inch thick; nontapered.

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A, except with maximum perm rating of 0.01 US perms, a minimum puncture resistance of 2260 grams and a minimum tensile strength of 57 lbf/in. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulation Solutions, Inc.; Viper VaporCheck II, 15 mil, Class A.
 - b. Inteplast Group; Barrier-Bac VB-350, 16 mil.
 - c. Meadows, W. R., Inc.; Perminator, 15 mil.
 - d. Poly-America; Husky Yellow Guard, 15 mil.
 - e. Raven Industries Inc.; Vapor Block 15.
 - f. Stego Industries, LLC.; Stego Wrap Vapor Barrier 15 mil.

2.8 GRANULAR DRAINAGE FILL/ CAPILLARY BREAK MATERIAL

- A. Granular Drainage Fill (033000.A15): 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. 4 sieve.

2.9 PERIMETER INSULATION

- A. Foam-Plastic Board Insulation (072100.A01): Provide one of the following:
 - 1. Provide extruded-polystyrene board insulation complying with 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.
 - a. Type IV, 25 psi.
 - 2. Provide molded polystyrene board insulation complying with ASTM C 578.
 - a. Type IX, 25 psi.
 - b. Basis-of-Design Product: ACH Foam Technologies; "Foam-Control Plus+ 250".

2.10 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment (033000.A21): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces, while improving slip resistance.
1. Basis-of-Design Products: Subject to compliance with requirements, provide Curecrete Distribution Inc.; "Ashford Formula" or SpecChem; "SpecHard" or comparable product meeting specified performance requirements, submitted to and accepted by Architect prior to bidding.
 2. Performance Criteria:
 - a. Abrasion Resistance: Improves abrasion resistance by not less than 30 percent over untreated concrete when tested in accordance with ASTM C 779.
 - b. Coefficient of Friction: ASTM C 1028, on steel-troweled concrete samples versus tile, reduces slippage as follows:
 - 1) Dry: 0.71 untreated and with treatment not less than 0.86.
 - 2) Wet: 0.47 untreated and with treatment not less than 0.69.
 - c. Hardening: Improves hardness by not less than 35 percent over untreated concrete when tested in accordance with ASTM C 39 after 28 days.
 - d. Impact Resistance: Improves impact resistance by not less than 13 percent over untreated concrete when tested in accordance with ASTM C 805, rebound number.

2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Confilm.
 - b. Conspec by Dayton Superior; Aquafilm.
 - c. Dayton Superior Corporation; Sure Film (J-74).
 - d. Euclid Chemical Company (The), an RPM company; Eucobar.
 - e. L&M Construction Chemicals, Inc.; E-CON.
 - f. Meadows, W. R., Inc.; EVAPRE.
 - g. SpecChem, LLC; Spec Film
 - h. Unitex; PRO-FILM.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
1. For areas to receive decorative polished concrete, use membrane forming curing compound as specified under Paragraph 2.13.D in this section.
- A. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 200.
 - b. Conspec by Dayton Superior; W.B. Resin Cure.
 - c. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - d. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - e. L&M Construction Chemicals, Inc.; L&M Cure R.
 - f. Meadows, W. R., Inc.; 1100-CLEAR.
 - g. SpecChem, LLC; Spec Rez Clear.
 2. For use in areas with decorative polished concrete, coordination with concrete polisher to remove curing membrane during grinding and polishing for decorative concrete.
 3. For use in areas with exterior concrete flatwork not indicated within Civil Drawings.

2.12 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips (033000.A22): ASTM D 1751, asphalt-saturated cellulosic fiber or W. R. Meadows; "Deck-O-Foam". Thickness for expansion joint filler strip shall be ½ inch, unless otherwise indicated.
1. For isolation joint filler strips, provide 30# asphalt saturated felt.
- B. Semi-rigid Joint Filler (033000.A23): Two-component, semi-rigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 85 to 95 per ASTM D 2240.

- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Temporary Floor Protection System: Subject to compliance with requirements provide "Ram Board" by Ram Board or a comparable product submitted to and accepted by Architect prior to bidding with the following product characteristics.
 1. Description: Fiber-reinforced protection board designed to allow new concrete to cure while absorbing impacts
 2. Material Thickness: 46 mils
 3. Wall Guard Feature: Board shall be designed by manufacturer to fold for protection of adjacent walls up to 8 inches above finished floor.
 4. Floor protection systems requiring application of a liquid base coat shall be prohibited.
 5. Provide manufacturer's recommended seaming tape, vapor curing tape, and edge tape at locations recommended in writing by manufacturer.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 1. Basis of Design: Subject to compliance with requirements, Provide "Ultraplan 1 Plus" by MAPEI or a comparable product with the following characteristics.
 2. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 3. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 4. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 5. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150/C 150M, 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 > at 28 days when tested according to ASTM C 109/C 109M.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- A. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- B. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use waterproofing (capillary break) admixture in concrete mixtures for slabs on grade and trenching repair for existing slabs on grade.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 4. 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 w/c ratio below 0.50.
 5. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 6. Use shrinkage reducing admixture in concrete topping slabs to receive a polished concrete finish.
- C. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Foundation Walls and Fin Walls: Normal-weight concrete.
1. Minimum Compressive Strength: 4500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.51.
 3. Slump Limit: 4 inches, plus or minus 1 inch or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- B. Slabs-on-Grade: Normal-weight concrete.
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
 5. Steel-Fiber Reinforcement: Add to concrete mixture, according to manufacturer's written instructions, at a rate of 50 lb/cu. yd.
 6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4 lb/cu. yd.
- C. Slabs-on-Grade (Exterior stoop slabs): Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches, plus or minus 1 inch.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

2.16 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M **and ASTM C 1116/C 1116M**, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, 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.
 2. Waterproofing (Capillary Break) Admixture shall be added at the jobsite before discharge in accordance with admixture manufacturer's written instructions. The admixture manufacturer's representative shall be present at time of dosing admixture and initial concrete placement. Use for all concrete slabs on grade.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Utilize sides of trenches for forms whenever possible. Where sides of trenches cannot be used; design, erect, support and maintain formwork to support vertical, lateral, static and dynamic loads that might be applied until such loads can be supported by concrete structure.
- D. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class C, 1/2 inch for rough-formed finished surfaces, not exposed to view in final position.
- E. Construct forms tight enough to prevent loss of concrete mortar.

- F. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
 - 3. Construct forms tight enough to prevent loss of concrete mortar.
- G. 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.
- H. 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.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. Form openings, chases, offsets, sinkages, keyways, ~~reglets~~, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
 - 1. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 PERIMETER INSULATION

- A. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
- B. On vertical footing and foundation wall surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 - 1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.
- C. Under refrigerator and freezer, set insulation boards in 2 layers with each layer 2 inches thick. Offset boards on sides and ends 12 inches from previous layer.

3.4 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 (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 3. Do not cut or puncture vapor retarder.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 75 percent of 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 - C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not 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.

3.5 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. 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.

3.6 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders for Slabs on Grade: Following leveling and tamping of granular drainage fill course for building slabs on grade, place vapor retarder sheet with longest dimension parallel with direction of pour to create a monolithic membrane. Lap vapor retarder over and seal to footings, foundation, strip footings and grade beam as occurs. Place, protect, and repair sheet vapor retarder according to ASTM E 1643, manufacturer's written instructions and as follows:
 1. Lap joints 6 inches and seal with manufacturers' recommended tape.
 2. Seal utility and column penetrations with pipe boot made from vapor retarder material, seal with pressure sensitive tape and vapor retarder manufacturer's recommended mastic.
 3. Repair punctures and tears with patches of vapor retarder material, lapping 6 inches on all sides and sealing with pressure sensitive tape.

3.7 GRANULAR DRAINAGE FILL

- A. Granular Drainage/Capillary Break Fill Course: Cover structural (low volume change) fill material with not less than 4 inches of granular drainage fill material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 1/2 inch.
 1. Compaction Requirements: Compact to within 95 percent maximum density in accordance with ASTM C 698, Standard Proctor compaction, at workable moisture content.
 2. Refer to Section 313200 "Subsoil Stabilization" for additional requirements regarding granular drainage fill.

3.8 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.9 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete. Align construction joint within rustications attached to form-facing material as occurs.
 - 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 at 100 feet maximum. 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.
 - 8. At Load Transfer Joints: Provide one of the following:
 - a. 2 by 4 inch continuous keyway.
 - b. One #4 by 12 inch long smooth dowel. Space dowels at 24 inches on center, unless otherwise indicated.
 - c. Diamond dowel system.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - a. Where joints are not specifically indicated, space joints at 15 feet on center (area not to exceed 225 sq ft.). For polished concrete, space joints at 10 feet on center (area not to exceed 100 sq ft.).
 - b. Begin saw cutting of joint no later than 12 hours after finishing.
- 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 Section 079200 "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. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.10 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless water was withheld at batch plant, amount withheld was documented in writing and adding withheld water is acceptable to Architect.

- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth not to 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. Do not permit vibrators to contact forms.
- 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, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.11 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish (033000.A16): As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. For architectural concrete exposed to view on the interior of the building, fins and other projections shall be removed flush with adjacent surface of concrete.
 - 2. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish (033000.A17): Apply the following to smooth-formed-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - a. Apply to concrete surfaces exposed to public view on lightpole bases.
- 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.

3.12 EXPOSED-AGGREGATE FINISHES

- A. Scrubbed Finish: After concrete has achieved a compressive strength from 1000 to 1500 psi, apply scrubbed finish. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed. Rinse scrubbed surfaces with clean water. Maintain continuity of finish on each surface or area of Work. Remove only enough concrete mortar from surfaces to match design reference sample or mockup.
- B. High-Pressure Water-Jet Finish: Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi. Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.

1. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in reveal projection to match design reference sample or mockup.
- C. Abrasive-Blast Finish: Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at same age for uniform results.
1. Surface Continuity: Perform abrasive-blast finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in depths of blast to match design reference sample or mockup.
 2. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
 3. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows:
 - a. Brush: Remove cement matrix to dull surface sheen and expose face of fine aggregate; with no significant reveal.
 - b. Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; with maximum reveal of 1/16 inch.
 - c. Medium: Generally expose coarse aggregate; with slight reveal, a maximum of 1/4 inch.
 - d. Heavy: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter; with reveal range of 1/4 to 1/2 inch.
- D. Bushhammer Finish: Allow concrete to cure at least 14 days before starting bushhammer surface finish operations.
1. Surface Continuity: Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances of cut as shown on Drawings or to match design reference sample or mockup.
 2. Surface Cut: Maintain required depth of cut and general aggregate exposure. Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
 3. Remove impressions of formwork and form facings with exception of tie holes.

3.13 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. 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 to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, and built-up or membrane roofing.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system. Do not burnish concrete.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - b. Specified overall values of flatness, F(F) 30; with minimum local values of flatness, F(F) 24; for elevated slabs.
 - c. Specified overall values of flatness, F(F) 45; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 24, for slabs to receive polished concrete finish.
 3. Gymnasium Floor: Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
 4. Finish slab repairs at trenches to be flush with adjacent concrete surfaces.

- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish (033000.A18): Apply a broom finish to traffic surfaces of exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.14 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 - 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.15 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, as follows:
 - 1. 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. Use moisture-retaining covers to cure concrete slab surfaces to receive all types of floor coverings.
 - b. Use moisture-retaining covers to cure concrete slab surfaces to receive penetrating liquid floor treatments, sealed concrete floor treatments and decorative polished concrete floor treatment.
 - 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

F. Temporary Floor Protection System:

1. Cover polished concrete floors with temporary floor protection system prior to and after completion of polished concrete floor finish.
2. Temporary floor protection system shall be maintained in good condition as recommended by manufacturer until construction activities are complete.

3.16 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 28 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.17 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 one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid 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.

1. Where control/contraction joints extend to the exterior of the building, beyond aluminum storefront, curtain wall and similar framing, completely fill joints with semi-rigid joint filler from exterior to inside face of framing. Exposed joint shall be completely filled and made water-tight.
2. Where control/contraction joints occur in floors indicated to receive penetrating sealed concrete finish.

3.18 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 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.19 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage 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.
1. Waterproofing (capillary break) admixture manufacturer shall test new concrete slabs for permeability.
- C. Inspections:
1. Steel reinforcement placement.
 2. Headed bolts and studs.
 3. Verification of use of required design mixture.
 4. Concrete placement, including conveying and depositing.
 5. Curing procedures and maintenance of curing temperature.
 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
 7. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 7. 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.
 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. 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.
 11. 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/C 42M or by other methods as directed by Architect.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing or within 72 hours of concrete placement, whichever comes first.

3.20 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

3.21 PROTECTION OF FLOORS TO RECEIVE CONCRETE POLISHING

- A. Protect polished concrete floor finish from damage and staining during construction operations. Where temporary covering is required for this purpose, comply with chemical manufacturer's recommendations for protective materials and method of their application. Remove temporary covering just prior to cleaning and final inspection.

END OF SECTION 033000

SECTION 033523 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes provision for decorative polished concrete floor finish, including but not limited to:
 - 1. Preparation of cast-in-place concrete floor slabs.
 - a. Joint and crack filling.
 - b. Grinding and surface preparation.
 - 2. Dry or Wet Polishing Concrete Methods
 - a. Mechanical grinding and polishing to achieve surface microtexture range.
 - b. Application of concrete hardener.
 - c. Chemically treating and mechanically refining slab to prevent vapor and stain transmission.
 - 3. Cleaning and filling contraction/control joints in slabs.
 - 4. Curing protection, high traction dynamic coefficient of friction (DCOF) baseline and handover of finished floor.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for concrete-not designated as polished concrete.

1.2 REFERENCES

- A. ASTM International
 - 1. ASTM C 779 Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
 - 2. ASTM C 309 Standard Test Method for Liquid Membrane-Forming Compounds for Curing Concrete
 - 3. ASTM E 96 Standard Test Method for Water Vapor Transmission of Materials
- B. Concrete Polishing Council (CPC).
- C. National Floor Safety Institute (NFSI):
 - 1. NFSI Test Method 101-A "Standard for Evaluating High-Traction Flooring Materials, Coatings and Finishes."
 - 2. ANSI B101.3 Test Method for Measuring Wet DCOF of Common Hard-Surface Floor Materials
 - a. National Floor Safety Institute 817.749.1700, www.NFSI.org.
- D. OSHA Regulatory and other References:
 - 1. 29 CFR 1926.1153 Crystalline Silica Standard.
 - 2. ASME B46.1-2009 (R2002), Surface Texture Grade (Surface Roughness, Waviness, and Lay)

1.3 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.
- B. Refined Polished Concrete Floor Finish: Defined as mechanical multi diamond concrete processing that creates non-peeling calcium silicate hydrate (C-S-H) layer that is physically resilient to wear and dusting, chemically resistant to staining and vapor transmission and has high traction Dynamic Coefficient of Friction (DCOF) as defined by ANSI B101.3 requirements.
- C. Stain and Vapor Resistant Finish: A polished concrete floor finish meeting ASTM E96 and ASTM C309 without negatively affecting performance of DCOF.
- D. Dyes: Extremely fine molecules of color solvent or dye for mixing with water or acetone that is designed to penetrate and color concrete surface.
- E. Polished Concrete Aggregate Exposure Classifications as defined by CPC:
 - 1. Class A – Cement Fines Finish: Surface exposure shall be as follows:
 - a. 85 to 95 percent cement fines.
 - b. 5 to 15 percent fine aggregate.

2. Class B - Fine Aggregate Finish: Surface exposure shall be as follows:
 - a. 85 to 95 percent fine aggregate.
 - b. 5 to 15 percent blend of cement fines and coarse aggregate.
 3. Class C - Coarse Aggregate Finish: Surface exposure shall be as follows:
 - a. 80 to 90 percent coarse aggregate.
 - b. 10 to 20 percent blend of cement fines and fine aggregate.
- F. Distinctness-of-Image (DOI) Gloss: The sharpness of images of objects produced by reflection at a polished surface, sometimes called "image clarity".
1. Measurement by Image Clarity Meter according to ASTM D 5767: The DOI, Image Clarity Value, obtained from this test method shall range from 0 to 100 with a value of 100 representing perfect DOI (image clarity).
- G. Haze: The cloudiness or milky appearance of images of objects produced by reflection in a polished surface.
1. Measurement by Glossmeter according to ASTM D 4039: The Haze Index, obtained from this test method, is computed by using the numeric difference between the value of specular gloss at 60 degrees and the value of specular gloss at 20 degrees.
- H. Polished Concrete Appearance Levels as defined by CPC:
1. Level 1 – Flat (Ground) Appearance: Images of objects being reflected have a flat appearance.
 - a. DOI Image Clarity Value: 0 to 9 percent.
 - b. Haze Index: Less than 10 percent.
 2. Level 2 – Satin (Honed) Appearance: Images of objects being reflected have a matte appearance.
 - a. DOI Image Clarity Value: 10 to 39 percent.
 - b. Haze Index: Less than 10 percent.
 3. Level 3 – Polished Appearance: Images of objects being reflected do not have a sharp and crisp appearance but can be easily identified.
 - a. DOI Image Clarity Value: 40 to 69 percent.
 - b. Haze Index: Less than 10 percent.
 4. Level 4 – Highly Polished Appearance: Images of objects being reflected have a sharp and crisp appearance as would be seen in a near-mirror like reflection. May require grouting.
 - a. DOI Image Clarity Value: 70 to 100 percent.
 - b. Haze Index: Less than 10 percent.
- I. Dynamic Coefficient of Friction (DCOF): The ratio of the horizontal component of force applied to a body required to overcome resistance to movement when the body is already in motion divided by the vertical component of the weight of the body or force applied to the surface where movement occurs.
- J. Dynamic Wet Coefficient of Friction (DWCOF): Defined as the frictional resistance created once an object is already in motion and in wet conditions. This value shall be determined in accordance with ANSI/NFSI B101.3.
- K. Surface Texture Grade (STG)/Roughness Average (Ra): Defined as the average value of profile heights as determined in accordance with ASME B46.1 – Surface Texture Grade (STG). Units of measure are μin (microinches).
1. Refinement Levels: Defined as a visual function of the Roughness Average (Ra) as follows:
 - a. Matte Finish: 32 μin (microinches)
 - b. Satin: 24 μin (microinches)
 - c. SemiGloss: 16 μin (microinches)
 - d. Glossy: 6 μin (microinches)

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Prior to placing concrete for areas scheduled to receive decorative polished concrete finish, conduct conference at Project site to comply with requirements in applicable Division 1 Sections and as follows:
1. Required Attendees
 - a. Owner, Architect, and Construction Manager.
 - b. Contractor, including supervisor/lead foreman.
 - c. Concrete producer.

- d. Concrete finisher, including supervisor/lead foreman.
 - e. Concrete polisher, including supervisor/lead foreman.
 - f. Technical representative of each type of liquid applied product manufacturer.
 - g. Independent testing agency responsible for concrete design mixtures.
2. Agenda: Polisher shall demonstrate understanding of work required by reviewing and discussing procedures for, but not limited to, following:
- a. Tour field mockup and representative areas of required work, discuss and evaluate for compliance with required Contract Documents, including substrate conditions, surface preparation, sequence of procedures and other preparatory work performed by other installers and related trades.
 - b. Review Contract Document requirements.
 - c. Review approved submittals and field mockup.
 - d. Review procedures, including, but not limited to:
 - 1) Specified curing methods and procedures, in addition to disposal of concrete slurry and dust.
 - 2) Details for each step of grinding, polishing, and roughness average (Ra) recording operations.
 - 3) OSHA Silica regulation compliance.
 - 4) Application of liquid applied products, including colorants.
 - 5) Protecting concrete floor surfaces during construction and prior to polishing process begins.
 - 6) Protecting polished concrete floors after polishing work is completed.
3. Reports: Record discussions, including decisions and agreements reached, and furnish copy of record to each party in attendance.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated and specified. Include mixing and application instructions for each product. Also include liquid chemical manufacturer's maintenance and cleaning instructions.
- B. Shop drawings, clearly indicating layout of decorative saw cuts and colors, location of columns, doorways, enclosing walls/partitions and built-in cabinets. Show installation details at any special conditions.
- C. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.
- D. Samples for Initial Selection:
 - 1. Submit color samples for joint sealants and other treatments for contraction/control joints. Samples shall be in the form of actual samples, or may be in the form of sealant manufacturer's color charts. Color samples shall indicate full range of available colors.
- E. Samples for Verification: For each type of exposed color.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer/Applicator:
 - 1. Submit written letters from chemical manufacturer confirming that installer/applicator has been certified and/or trained by chemical manufacturer. Also submit in writing, evidence of at least seven (7) years' experience in grinding concrete, installing/applying dyes and stains, installing/applying hardeners/densifiers/sealers and polishing concrete similar in size to those areas required for this Project. Include a list of jobs completed in the states of Missouri, Colorado, Kansas, Texas, and contact information on Architect, General Contractor or Construction Manager, as applicable, and Owner. List each type of material used, detailed procedure for installation/application, quantity installed and dates completed.
 - a. Furnish certifications for polished concrete.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Liquid floor treatments.
 - 2. Floor finish system including; repair and patch materials, joint saw, clean and fill materials, liquid floor treatment and mechanical refinement.
- C. Field Quality Control: Submit certified test reports by an independent testing laboratory for the following:
 - 1. Dynamic Wet Coefficient of Friction (DCOF) in accordance with ANSI/NFSI B101.3.
 - 2. Finished Roughness Average (Ra) levels in accordance with ASME B46.1 measuring procedure.
- D. Minutes of pre-installation conference.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Requirements: For inclusion in Maintenance Manuals.
1. Include manufacturer's instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use.
 2. Include precautions against cleaning products and methods which may be detrimental to finishes and performance.
 3. Include subcontractor's dynamic coefficient of friction (DCOF) and roughness average (Ra) plan to maintain high traction DCOF, vapor and stain barrier.

1.8 QUALITY ASSURANCE

- A. Installer/Polisher Qualifications: Engage an Installer/Polisher, experienced in performing specified work similar in design, products and extent to scope of this Project; with a record of successful in-service performance. Installer/polisher shall be certified and/or trained by liquid chemical manufacturer with experience in application and installation of systems similar to complexity to those required for this Project, plus the following.
1. Installer shall have a minimum of seven (7) years continuous experience under current company name; in grinding concrete, installing/applying water-based dyes/stains, installing/applying hardeners/densifiers/sealers, cutting compounds, and polishing concrete.
 2. Installer/polisher shall submit a reference list, complete with Owner, Architect, General Contractor or Construction Manager; phone number of each, and square footage installed of at least seven (7) completed projects in the states of Missouri, Colorado, Texas, and/or Kansas similar in size and specification.
 3. Installer/polisher shall have sufficient production capability, facilities and personnel to produce specified work.
 4. Installer/polisher shall assign experienced mechanics from previous applications, including lead mechanic/supervisor, for this Project.
 - a. Lead mechanic/supervisor shall be currently certified as a Craftsman by CPC.
 - b. Lead mechanic/supervisor shall be familiar with technical and practical instructions on achieving the performance similar to that specified with regard to the requirements in ASME B46.1, NFSI/ANSI B101.3, and NFSI Test Method 101-A.
 - c. Available installers shall include but not be limited to the following:
 - 1) Desco Floors, www.descofloors.com, (917) 608-7609
 - a) Contact: Brandon Godbey, brandon@descofloors.com
 - 2) Chase Industrial Floors, (512) 903-7700.
 - a) Contact: James Bell, cifloors@gmail.com
 - 3) Elegant Polishing (203) 430-3360.
 - a) Contact: info@elegantpolishing.com
 - 4) HJ Martin and Son, Inc, www.hjmartin.com, (920) 619-9983
 - a) Contact: Tim Lasure, tlasure@hjmartin.com
 - 5) Wilhelm Construction, www.fawilhelm.com; (317) 937-8422.
 - a) Contact: Larry Arthur, larryarthur@fawilhelm.com
 - 6) Meyer Najem, www.meyer-najem.com; (317) 577-0007.
 - a) Contact: Tim Russell, trussell@meyer-najem.com
 - 7) BCC, (503) 522-5319.
 - 8) Colorful Concrete Solutions, (262) 501-1972.
 - 9) DPR, (949) 554-4978.
 - 10) Floor Whisperer, (949) 300-6669.
 - 11) Pepper Construction, (740) 202-3455.

- D. Coefficient of Friction: Achieve the following dynamic coefficient of friction by field quality control testing in accordance with the following standards:
1. ANSI/NSFI B101.3 "Dynamic Coefficient of Friction"; achieve a minimum of 0.42 for level floor surface.
 - a. Resin matrix diamond tooling prohibited as DCOF levels can decrease through resin transfer.
 - b. "Silica stacking" prohibited as buildup of densifier on surface may reduce DCOF levels.
- E. Mock-Up: Before performing work of this Section, provide as many mockups required to verify selections made under submittals and to demonstrate aesthetic effects of coloring, grinding (aggregate exposure) and polishing for each type of finish. Apply surface finishes to concrete field samples in presence of Architect and Construction Manager. Provide workmanship and procedures as required to meet Architect's and Owner's approval. Approval does not constitute approval of deviations from Contract Documents, unless such deviations are specifically brought to the attention of and accepted by Architect in writing.
1. Mockup Sample: Apply polished concrete floor finish to mockup area to demonstrate workmanship to be expected for the Work, including but not limited to: typical decorative saw cutting, treatment of control/contraction joints, slab preparation and repairs, cleaning, coloring, grinding, application of hardener/densifier, polishing for Surface Texture Grade (STG)/Roughness Average (Ra), and application of finish sealer if required to meet performance benchmarks. Mockup shall also include hand-grinding along one edge of each half of sample to simulate conditions adjacent to a vertical wall.
 - a. Mockups shall be demonstrated as directed by Architect.
 - b. Mockup shall be located in existing art and science room in location to be determined by Architect and Owner.
 - c. Field sample criteria:
 - 1) Aggregate exposure to match Class B (Fine Aggregate Finish).
 - 2) Surface Texture Grade (STG)/ Roughness Average (Ra) shall be 24 µin (microinches) SemiGloss Finish, and as required to produce the following results:
 - a) Dynamic Coefficient of Friction: minimum of 0.42 for level floor surface per ANSI/NSFI B101.3.
 - b) Polished Concrete Appearance: Level 2 – Satin (Honed) Appearance.
 - d. Field samples shall be finished to desired uniformity of exposed aggregate, uniformity of color, uniformity of STG/Ra levels and treatment of joints. When approved, samples will serve as standard for the project.
 - e. Project architect approved mockup shall remain accessible to Architect and Owner after installation concrete polishing is complete for comparison with the Work.
 - f. Use same personnel, including supervisor/lead foreman, which will perform work.
 - g. Roughness Average (Ra) readings shall be taken of approved area and documented. Not less than 40 readings shall be taken for each approved finish and these values averaged. The average value shall be used as the basis for acceptability of finished areas for each color/finish.
 - h. Mockup may remain in place as completed work provided it is undamaged.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original undamaged packages or acceptable bulk containers. All packaging and containers shall bear manufacturer's labels indicating brand name and directions for storage.
- B. Store packaged materials to protect them from elements or physical damage and from freezing.

1.10 PROJECT CONDITIONS

- A. Concrete Damage and Stain Prevention: Construction Manager shall protect areas to receive decorative polished concrete floor finish at all times during construction to prevent damage and staining from; oils, dirt, metal rust, excessive water and other potentially damaging materials from effecting the finished concrete surface. Protection measures listed below shall begin as soon as possible after concrete is poured:
 1. Prohibit vehicle and scissor lift parking and driving over concrete surfaces to receive decorative concrete finish.
 2. Prohibit storage of any items over concrete surfaces to receive decorative floor finish for not less than 28 days after concrete placement.
 3. Protect from petroleum, oil, hydraulic fluids and other liquid dripping onto areas to receive the decorative concrete finish.
 - a. All hydraulic equipment shall be diapered to avoid concrete staining.
 4. Protect concrete slab areas to receive decorative floor finishing from contact with acids and acidic detergents.
 5. Avoid scissor lift and vehicle operation over curing polished floor finish according to manufacturer recommended instructions.

6. Pipe cutting machines shall not be allowed on areas to receive the decorative concrete finish
 7. Steel shall not be placed/stored on the concrete slab to avoid rust stains.
 8. All painters shall use drop cloths in areas to receive decorative concrete floor finish. Any paint on the slab shall be removed immediately.
 9. All trades shall be informed that the concrete slab areas to receive colored concrete floor finish are to be protected at all times, prior to and after decorative concrete floor finishing operations.
- B. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting decorative polished concrete floor system application.
1. Place decorative polished concrete floor system only when ambient temperature and temperature of base slabs are between 50 and 100 deg F.
 2. Do not commence work until the building can be maintained at a minimum temperature of 50 deg F for 48 hours before, during, and 48 hours after application. Provide adequate controlled ventilation and bright, uniform lighting during application and inspections.
- C. Sequencing: Perform work of this Section after all wet work, such as painting has been completed in areas scheduled to receive decorative polished concrete floor finish.
- D. Surfaces must be acceptable in accordance with decorative concrete Contractor's recommendations.
1. Notify Architect and Construction Manager in writing of unsuitable surfaces and conditions. Commencement of work implies acceptance of surfaces and working conditions.

1.11 WARRANTY

- A. Manufacturer's Warranty - Polished Finish: Provide 10 year manufacturer material warranty commencing at date of Substantial Completion. Manufacturer shall warrant to the Owner that the polished surface will remain water repellent, dustproof, hardened and abrasion and food/vapor stain resistant.

1.12 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Concrete surfaces shall be protected by means recommended in writing by polishing product manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide mechanical refinement methods for polished concrete floor systems. Requirements specific to dry polishing methods and wet polishing methods are indicated separately. Requirements indicated in this Section without a specific indication of the method used, shall apply to both methods.
1. Polished Concrete Floor System Properties: Finish shall be mechanically achieved with specified roughness average (Ra), clear appearance; meet or exceed ASTM C 309 and ASTM E 96 for stain resistance, provide minimum specified high traction DCOF in accordance with ANSI B101.3 and NFSI recommendations, , and require maintenance plan for aesthetics and DCOF after initial installation. Topical sealers/guards not allowed in conjunction with refinement and polishing of concrete, but may be used as required to meet vapor/stain resistance requirements.
- B. Finish Requirements: Finish for polished concrete slabs shall match approved mockup sample for aggregate exposure class and surface texture grade (STG)/roughness average (Ra) level:
1. Aggregate Exposure: Match Class B (Fine Aggregate Finish).
 2. Surface Texture Grade (STG)/Roughness Average (Ra): 16 μ in (microinches) burnish to semigloss finish.
 - a. Roughness Average (Ra) shall be as required to produce the following results:
 - 1) Dynamic Coefficient of Friction: minimum of 0.42 for level floor surface per ANSI/NFSI B101.3.
 - 2) Polished Concrete Appearance: Level 3 – Polished Appearance.
 3. Material Color Schedule finish designation: CS1, PC.
 4. Refer to Room Finish and Material Color Schedules for polished concrete finish locations.

2.2 MATERIALS FOR WET POLISHING METHOD

- A. Basis of Specification Manufacturers: Reactive copolymerizing solids (RCS) architectural refined concrete floor finish system; densifier, diamond tooling, grinding apparatus, dust/slurry control equipment, concrete colorants, joint cleaning/cutting and filling, and protective commercial cover for polished floors. Deep penetrating concrete cutting compound and densification solutions specifically designed to harden and refine concrete. No sodium, potassium or lithium chemistry sealers/hardeners or densifiers may be used. Topical sealers and guards are prohibited. Architectural concrete floor will be resilient to stain without sacrificial coatings requiring reapplication. Subject to compliance with requirements provide complete architectural concrete finish systems from one of the following:
1. Element Five (E5), Specification Products, 888-881-1726, sales@specificationproducts.com
 2. BlendMax, Newtop Technologies, (512) 375-9915, info@newtoptechnologies.com
 3. Diamond Products Polishing, (309) 292 2438, anevener@diamondproducts.com
 4. The Juice, Sipco Global, (317) 606-9272, aanderson@sipcoglobal.com
 5. Comparable systems and products from other manufacturers will be considered, provided that they meet or exceed specified requirements, testing, and they are submitted to and approved by the Architect.
 6. Densifier/hardener products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.
- B. Concrete Colorants: Provide a translucent, pre-packaged liquid, water-based dye/stain formulated using with reactive copolymerizing solids (RCS) penetrating and wetting agents and extremely fine molecules of color. Dye/stains shall be non-flammable. Up to three colors may be selected by the Architect. Manufacturer's standard color offering shall not be less than 20 colors.
- C. Water: Potable, free from deleterious material that may affect color stability. Check that pH of local water will react well with Calcium Silicate Hydrate (C-S-H) production during densification.
- D. Patching Compound: Cement based compound compatible with traditional and reactive copolymerizing solids (RCS) technology types which when mixed with dust salvaged from grinding process, forms a paste that hardens when surface imperfections are filled.
1. Imperfections include, but are not limited to: exposed air pockets, holes due to lost aggregate, etc.

2.3 MATERIALS FOR DRY POLISHING METHOD

- A. Basis of Specification Manufacturers: Subject to compliance with requirements provide liquid chemical products from the one of the following:
1. American Decorative Concrete Supply Company.
 2. Husqvarna.
 3. The Bomanite Company.
 4. Hi-Tech Systems.
 5. L&M Construction Chemicals, Inc.
 6. ProSoCo, Inc.
 7. Vexcon Chemicals, Inc.
 8. Comparable systems and products from other manufacturers will be considered, provided that they meet or exceed specified requirements and they are submitted to and approved by the Architect.
- B. Concrete Dyes/Stains: Provide a translucent, pre-packaged liquid, solvent-based dye/stain formulated using active silicates, penetrating and wetting agents and extremely fine molecules of color. Up to three colors may be selected by the Architect. Manufacturer's standard color offering shall not be less than 20 colors.
1. Manufacturer's and Products – Basis of Design:
 - a. Vexcon Chemicals, Inc.; "Certi-Shine Stain FSR"
 - b. American Decorative Concrete Supply Company; "AmeriPolish" polished concrete dye.
 - c. Bomanite; "Panete Teres" concrete dye.
 - d. Comparable products from other manufacturers will be considered when submitted to and approved by the Architect prior to bidding.
 2. Colors: As selected by Architect to match colors selected on Material Finish Legend.
 - a. Material Finish Legend Designations: CS1.

- C. Spall/Crack Repair/Patching Compound: Compound composed of 40 percent portland cement, 45 percent limestone, and 15 percent vinyl acetate copolymer, when mixed with dust salvaged from grinding process, forms a paste that hardens when surface imperfections are filled.
 - 1. Imperfections include, but are not limited to: exposed air pockets, holes due to lost aggregate, etc.
 - 2. Manufacturers and Products:
 - a. Basis of Design: HiTech Systems "Spall-FX". (615) 756.8008
 - b. Comparable products from other manufacturers will be considered when submitted to and approved by the Architect prior to bidding.

- D. Vapor and Stain Resistant Sealer- Food, Vapor, and Chemical Resistant Sealer: Provide a non-film forming; sealer designed to be used on concrete surfaces previously hardened and densified that do not reduce DCOF. Sealer shall have a VOC content of not greater than 40 g/L and meet benchmarks described in ASTM C309 and ASTM E96.
 - 1. Manufacturers and Products:
 - a. Basis of Design: Bomanite "Vitrafinish" for general use. At restrooms Husqvarna, "Hiperseal"
 - b. Vexcon Chemicals, Inc.; "Certi-Shine Fixative".
 - c. Ameripolish; "SR2 WB Stain Resistor".
 - d. Comparable products from other manufacturers will be considered when submitted to and approved by the Architect prior to bidding.

2.4 MATERIALS FOR WET POLISHING METHOD AND DRY POLISHING METHOD

- A. Pigmented Micro Stains and Colorants: Provide manufacturer's pigmented microstain having fine pigment particles ($<3.9 \times 10^{-4}$ inches) suspended in solvent based solution that penetrates concrete and reacts with calcium hydroxide to lock in color particles.
 - 1. Basis of Design: Sika Schofield 651-788-3967.
 - a. Color: As selected from manufacturers' full range to match existing finish. May require a custom blend.
 - b. If colorants/stains/dyes found to be used in densifier or sealer applications to mask scratches and lack of refinement, floor will be corrected at no expense to the Owner.

- B. Liquid Hardener/Densifier: Provide an odorless, non-hazardous, penetrating type silicate, reactive copolymerizing solids, or silicate designed to react with free lime and calcium hydroxide in concrete to produce permanent chemical reaction that hardens and densifies concrete surface. Penetrating hardener/densifier shall be compatible with applied sealers, where are required to meet required performance benchmarks. Sealers shall not be of type that triggers nor contributes to surface alkali silicate reaction. Penetrating sealer shall have a VOC content of not greater than 40 g/L. Sodium densifiers not allowed. Densifiers containing coatings or sealer material such as epoxy, acrylic or latex not allowed. No exceptions. Micro void filler epoxy, latex or acrylic "pit grout" coatings shall be prohibited as they do not create calcium silicate hydrate (C-S-H) and artificially influence mechanical refinement of floor. No exceptions. If sealers, coatings are used to mimic refinement portion of polishing process floor will be corrected at no expense to the owner.
 - 1. Manufacturers and Products:
 - a. Basis of Design: Blendmax RCS.
 - b. Vexcon Chemicals, Inc.; "Certi-Shine Clear".
 - c. Scofield; Formula One.
 - d. Comparable products from other manufacturers will be considered when submitted to and approved by the Architect prior to bidding.

- C. Water: Potable, free from deleterious material that may affect color stability. Check that pH of local water will react well with Calcium Silicate Hydrate (C-S-H) production during densification.

- D. Joint Sealants: Semi-rigid 2-part polyurea type.
 - 1. Shore A Hardness: 70 to 80 when tested in accordance with ASTM D 2240.
 - 2. Tensile strength: Not less than 1160 pounds per square inch when tested in accordance with ASTM D 412.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Adhesives Technologies Corp.; Crackbond JF311.
 - b. Hi Tech Systems; Joint Fill.
 - c. Curecrete Distribution Company, Inc.: Ashford Crete-Fill.
 - d. L&M Construction Chemicals, Inc.: Joint Tite 750.
 - e. NewTop Technologies; Clean and Fill 50.
 - f. VersaFlex Incorporated; SL/75 Joint Filler.
 - g. Comparable products from other manufacturers will be considered when submitted to and accepted by Architect prior to bidding.

- E. Temporary Floor Protection System: Subject to compliance with requirements provide "Ram Board" by Ram Board or a comparable product submitted to and accepted by Architect prior to bidding with the following product characteristics.
 - 1. Description: Fiber-reinforced protection board designed to allow new concrete to cure while absorbing impacts
 - 2. Material Thickness: 46 mils
 - 3. Wall Guard Feature: Board shall be designed by manufacturer to fold for protection of adjacent walls up to 8 inches above finished floor.
 - 4. Floor protection systems requiring application of a liquid base coat shall be prohibited.
 - 5. Provide manufacturer's recommended seaming tape, vapor curing tape, and edge tape at locations recommended in writing by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Installer shall examine subfloor surfaces with Construction Manager and Architect present to verify all substrates and conditions are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from stains, cracks, holes, ridges, curing compounds and other coatings/contaminants which could interfere with application of decorative polished concrete floor system, and other defects impairing performance or appearance.
- B. Do not proceed with work of this Section until concrete slab surfaces are satisfactory. Commencement of decorative polished concrete flooring work is construed as applicator's acceptance of surfaces within particular area.

3.2 PREPARATION

- A. General: Comply with liquid chemical manufacturer's written instructions and recommendations for preparation of substrate in addition to the following:
 - 1. Remove hardware, hardware accessories, plates, machined surfaces, and similar items which are not to be colored; or provide surface-applied protection prior to surface preparation and coating. Remove these items if necessary for complete coating of the items and adjacent surfaces. Following completion of coating operations in each space or area, reinstall items removed, using workmen skilled in the trades involved.
 - 2. Clean surfaces before applying decorative polished concrete finish system. Schedule cleaning and coating application so dust and other contaminants will not fall on wet, newly coated surfaces.
 - 3. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of floor finishing chemicals. Cover adjoining and nearby surfaces of aluminum, glass, drywall, etc. where there is the possibility of the chemicals being deposited on surfaces. Immediately clean chemicals from adjoining surfaces, complying with manufacturer's cleaning recommendations.
 - a. Prevent spillage and runs of chemicals onto adjacent surfaced to best extent possible.
 - b. Protect adjacent materials and finishes from physical damage during finishing operations.
 - c. Provide protections as required and remove from site at completion of work.
- B. Moisture and Alkalinity Testing
 - 1. Perform moisture, and alkalinity tests on concrete slabs indicated to receive decorative floor finish to determine if surfaces are sufficiently cured and dry as well as to ascertain presence of curing compounds.
 - 2. No more than seven days prior to the scheduled installation, test the slab for moisture and alkalinity. Submit to the Architect and Construction Manager a written report on the moisture and alkaline condition of the slab. Submit test findings to Architect.
 - a. Test the concrete using a calcium chloride crystal test kit or perform relative humidity testing in accordance with ASTM F 2170 when recommended by liquid hardener/densifier manufacturer to suit conditions existing at the site in areas to receive decorative concrete floor finish.
 - b. Test the concrete for surface alkaline using pH test paper in accordance with ASTM F 710.
 - 3. Perform testing and document results for not less than every 1000 sq ft of floor area. Perform tests where resilient surfacing is to be installed. The concrete slab must have a minimum 28 days for proper curing to reach acceptable dryness prior to testing. Conduct tests after space has been maintained at a temperature of 50 deg F or higher for not less than 48 hours and relative humidity ranges from 30 to 50 percent.
 - 4. Acceptable Results:
 - a. Optimum emissions rate as acceptable to manufacturer for polishing system.
 - b. Optimum relative humidity level; as acceptable to manufacturer for polishing system.
 - c. Optimum alkalinity; pH between 8 and 10.

5. Do not proceed with flooring work until subfloor surfaces are satisfactory. Start of decorative concrete floor finish work is construed as applicator's acceptance of surfaces within particular area.
- C. Surface Preparation: Perform surface preparation and cleaning in compliance with the decorative polished concrete floor system (liquid chemical) manufacturer's written instructions for particular substrate conditions, and as specified.
1. Initial Preparatory Cleaning: Clean surfaces of concrete to receive decorative polished concrete floor system by removing stains, efflorescence, chalk, dust, dirt, release agents, grease and oils. Treat oil spots with oil emulsifier and oil absorber materials as recommended by chemical manufacturer.
 2. Initial Grinding: As recommended by polished concrete floor finish (chemical) manufacturer, mechanically sand/grind cured concrete surfaces to achieve levels used on approved field samples. Grinding shall also be done to level the slab as much as possible without exposing aggregate. Grinding machine shall have an integral dust extraction system.
 3. Final Preparatory Cleaning: Clean surfaces of concrete to receive colored concrete floor system by removing dust, dirt, and other debris left from saw cutting and grinding/sanding procedures.

3.3 POLISHING METHOD - APPLICATION OF COLORED CONCRETE FLOOR FINISH

- A. General: Begin application of decorative polished floor and stair finish as determined by application on approved field samples to achieve matching aggregate exposures, color intensities and sheen levels.
1. Surface Continuity: Perform finishing in as continuous an operation as possible, utilizing same work crew to maintain continuity of finish on each surface or area of work.
- B. Material Preparation: Carefully mix and prepare materials in compliance with the liquid chemical manufacturer's written instructions.
1. Stir materials before application to produce a mixture of uniform density and color, and as required during application.
- C. Colorant Application: Apply concrete dye/stain in strict accordance with dye/stain manufacturer's written instructions and to match application, color uniformity and color intensity on approved field mockup samples.
1. Maintain wet edge, working newly applied solution into edges of adjacent wet edges of previously treated surfaces.
 2. Maintain consistent saturation throughout application.
 3. Avoid splashing, dripping and puddling of solution on adjacent substrates.
 4. When color matches approved field mockup, neutralize as required by dye/stain manufacturer.
- D. Hardener/Densifier Application: Apply hardener/densifier/sealer in strict accordance with sealer manufacturer's written instructions, to match application and finish on approved field samples.
- E. Mechanical Polishing: Polish concrete in strict accordance with polishing system manufacturer's written instructions, to match application and finish on approved field samples.
- F. Joint Sealing: In strict accordance with floor finish system manufacturer's written instructions clean and fill control joints to match application and finish on approved field samples. Use joint filler and debris removal blade system, designed specifically for this purpose.
1. Do not fill moving isolation joints or expansion joints.
- G. Buffing/Burnishing: Burnish in strict accordance with floor finish system manufacturer's written instructions, to match application and finish on approved field samples.

3.4 POLISHING FOR CONCRETE FLOORS – WET AND DRY METHODS

- A. General: Begin application of decorative polished floor finish as determined by application on approved field mockup samples to achieve matching aggregate exposure and surface texture grade (STG)/roughness average (Ra) levels.
1. Surface Continuity: Perform finishing in as continuous an operation as possible, utilizing same work crew to maintain continuity of finish on each surface or area of work.
 2. Use hand equipment against walls for work of this Section as necessary to maintain uniformity of aggregate exposure and STG/Ra finish.
 3. Protection of Work Below Polishing Elevated Slabs: Protect finished and unfinished floor and wall surfaces below elevated slabs during concrete polishing. Residue from polishing operations shall be removed immediately from surfaces below elevated slabs.

- B. Sequence of Polishing: Perform polishing after partitions studs are erected, but before gypsum board is installed.
- C. Initial Grinding:
1. Prior to grinding, clean floor then fill control joints with semirigid joint sealant.
 2. Take and record initial Ra reading for Owner floor maintenance log.
 3. Begin refinement with appropriate tooling based on initial average roughness (Ra) measurements.
 4. Make sequential passes to achieve next step of refinement.
 5. Fill surface imperfections including, but not limited to, holes, surface damage, small and micro-cracks, air holes, pop-outs, and voids with original concrete matrix material from grinding so that filled areas can create calcium silicate hydrate (C-S-H) and match color and quality of concrete field.
 - a. Coating products such as epoxy grout, acrylic grout, or latex grout are non-cementitious and are prohibited.
 6. Achieve and record maximum refinement with each pass before proceeding to next average roughness (Ra) level and diamond tool pass.
 7. Clean floor using squeegee vacuum attachment or dust filtration system according to manufacturer instructions.
 8. Continue grinding until aggregate exposure matches approved field mockup sample.
- D. Liquid Hardener/Densifier Application:
1. Apply undiluted in strict accordance with liquid chemical manufacturer's written instructions, to match application and finish on approved field samples. Remove excess liquid to avoid silica stacking and potentially lowering DCOF, and allow to cure according to manufacturer's instructions.
- E. Refining and Polishing:
1. Mechanically refine and polish with liquid hardening agent to achieve specified Ra.
 2. Record STG/Ra average number in log.
 3. Using burnishing equipment and appropriate Ra level burnishing pads, burnish to finish meeting performance benchmarks of DCOF and stain resistance to match accepted mock-up sample. Compare to mockup sample.
 4. Do not use epoxy matrix diamond tooling which might transfer resin to floor surface and reduce DCOF and create epoxy film coating.
 5. Joint Sealing: After final polishing, cut out and replace semirigid joint sealant damaged during grinding process. Intent is to have joint sealant as continuous as possible.
- F. Final Polished Concrete Floor Finish Properties:
1. Aggregate Exposure:
 - a. As indicated under sub-section 2.1.B Finish Requirements.
 2. Finished Surface Texture Grade (STG)/Roughness Average (Ra) Levels:
 - a. As indicated under sub-section 2.1.B Finish Requirements.
- G. Sealer and Coating Installation
1. Roughness Average (Ra) measurements shall be taken prior to application of sealers, guards, or coatings.
 2. Install protective sealer according to manufacturer's instructions to meet vapor/stain resistance benchmarks.
 3. Roughness Average (RA) deviation is allowable up to 5% after sealer installation. No deviation shall be permitted on DCOF performance requirements.

- H. Temporary Floor Protection System:
 - 1. Cover polished concrete floors with temporary floor protection system after completion of polished concrete floor finish.
 - 2. Temporary floor protection system shall be maintained in good condition as recommended by manufacturer until construction activities are complete.

3.5 FIELD QUALITY CONTROL

- A. Field Testing: Engage a qualified testing agency to perform field testing according to ANSI/NFSI 101.3 to determine if polished concrete floor finish complies with specified dynamic coefficient of friction.
 - 1. Performance Criteria: Decorative polished concrete floor finish shall achieve not less than 0.42 for level floor surfaces.

3.6 CLOSEOUT ACTIVITIES

- A. Maintenance Training: Authorized representative of concrete polishing materials manufacturer shall train Owner's designated personnel in proper procedures for maintaining polished concrete floor.
- B. Contractor shall hand in and review Roughness Average (Ra) documentation for DCOF maintenance, as well as cleaning maintenance with owner's facility maintenance representative responsible for facility floor maintenance. Train Owner's representative on proper maintenance of new floor finish.

3.7 CLEANUP AND PROTECTION

- A. Clean-Up: At the end of each work day, remove rubbish, empty cans, rags and other discarded materials from site.
 - 1. Upon completion of work, clean up spattered surfaces. Remove spattered coatings by washing, scraping or other proper methods. Do not scratch or damage adjacent finished surfaces.
- B. Cure decorative polished concrete floor finish, in compliance with chemical manufacturer's directions, to prevent their contamination, staining and damage.
- C. Clean decorative polished concrete floors just prior to substantial completion. Use materials and procedures recommended by chemical manufacturer.
- D. Protect decorative polished concrete floor finish from damage and staining during construction operations. Where temporary covering is required for this purpose, comply with chemical manufacturer's recommendations for protective materials and method of their application. Remove temporary covering just prior to cleaning and final inspection.

END OF SECTION 033523

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural steel (051200.A01).
 - 2. Grout (051200.A08).
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for any allowances effecting work of this Section.
 - 2. Section 012200 "Unit Prices" for any unit prices effecting work of this Section.
 - 3. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 4. Section 055000 "Metal Fabrications" for steel lintels not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before installation of structural steel framing, review procedures and tolerances for ensuring quality of steel framing materials. Require representatives of each entity directly concerned with structural steel framing to attend, including but not limited to the following:
 - a. Owner's representative
 - b. Architect.
 - c. Contractor's superintendent.
 - d. Structural Steel Framing subcontractor.
 - e. Manufacturer's representative for structural steel framing.
 - 2. Review field quality control measures for the following items:
 - a. Field dimensions and tolerances for structural steel framing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator and professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. Shop primers.
 - 6. Nonshrink grout.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
 - 1. Non-certified fabricators shall submit their qualifications with their bid. Qualifications shall be submitted on AIA Document A305 "Qualifications Statement", include the following for each project listed: references for at least 3 projects, identify engineer-of-record, tonnage of steel fabricated and type of steel fabricated (structural, miscellaneous, etc.).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
 - 1. A firm with not less than ten (10) years of experience under the current name.
 - 2. Must have completed five (5) projects within the past 5 years of comparable size and scope.
 - 3. Non-certified erectors shall submit their qualifications with their bid. Qualifications shall be submitted on AIA Document A305 "Qualifications Statement", include the following for each project listed: references for at least 3 projects, identify engineer-of-record, tonnage of steel erected and type of steel erected (structural, miscellaneous, etc.).
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- D. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections and moment connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 1. Select and complete connections using schematic details indicated and AISC 360.
 2. Use Allowable Stress Design; data are given at service-load level.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: Combined system of braced frame and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Channels (051200.A03), Angles (051200.A04), M, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar (051200.A05): ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections (051200.A06): ASTM A 500/A 500M, Grade B, structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.
 1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.
- C. 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: Plain.
- D. Box Bolts / Blind Bolts:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide LNA Solutions; "BoxBolt Type C Blind Fastener" or comparable product submitted to and accepted by Architect prior to bidding.
 2. Product Characteristics:
 - a. Core bolt shall be manufactured from steel complying with ISO 4017, Grade 8.8.
 - b. Body, collar and cone shall be manufactured from steel complying with BS EN 10083, Grade 1.1151.
 - c. Finish shall be manufacturer's proprietary coating similar to GEOMET 321 XL.
 3. Product Certifications: Boxbolt/Blind Bolt shall be ICC Certified.

- E. Unheaded Anchor Rods: ASTM F 1554, Grade 55, weldable.
 1. Configuration: Straight.
 2. Nuts: ASTM A 563 heavy-hex carbon steel.
 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 5. Finish for Interior Locations: Plain.
 6. Finish for Exterior or Below Grade Locations: Hot dip zinc coating, ASTM A 153, Class C.
- F. Threaded Rods: ASTM A 36/A 36M.
 1. Nuts: ASTM A 563 heavy-hex carbon steel.
 2. Washers: ASTM A 36/A 36M carbon steel.
 3. Finish for Interior Locations: Plain.
 4. Finish for Exterior or Below Grade Locations: Hot dip zinc coating, ASTM A 153, Class C.
- G. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.4 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer compatible with topcoat.
- B. Galvanizing Repair Paint: ASTM A 780/A 780M.

2.5 FILLER

- A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.6 GROUT (051200.A08)

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning," or SSPC-SP 2, "Hand Tool Cleaning."
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.
 - 2. Erection plates shall be removed after welding and prior to finishing.
 - 3. Exposed welded connections lower than 25'-0" above finished floor shall be finished to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.

2.9 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 of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
 - 6. Surfaces enclosed in interior construction (not exposed-to-view in final position).
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. 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 two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.

- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.
- F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents
- G. Special Inspections: Owner will retain and pay for the services of a qualified independent inspection agency acceptable to the Architect to conduct special inspections of all structural welding and high-strength bolting in accordance with applicable requirements of Section 1704 of the International Building Code, latest edition, as adopted and amended by authority having jurisdiction. The inspection agency shall inspect the work, prepare and submit periodic reports and final reports to City Code Officials, Architect, and Owner in compliance with building code requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Structural Engineer of Record. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened-

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

- B. Touchup Prime Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following applications of cold-formed metal framing (054000.A01):
 - 1. Load-bearing wall framing.
 - 2. Interior load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
 - 3. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
 - 4. Roof rafter framing.
 - 5. Soffit framing.
 - 6. Miscellaneous framing and furring members.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
 - 2. Section 092116 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 3. 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. Delegated-Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency and professional engineer.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Miscellaneous structural clips and accessories.
- E. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
 - 1. All Steel and Gypsum Products.
 - 2. CEMCO; California Expanded Metal Products Company.
 - 3. Clark-Dietrich Metal Framing.
 - 4. Custom Stud, Inc.
 - 5. MarinoWare; a division of Ware Industries.
 - 6. MBA Building Supplies.
 - 7. SCAFCO Corporation.
 - 8. Steel Construction Systems.
 - 9. Steel Network, Inc.
 - 10. Steel Structural Systems.
 - 11. United Metal Products, Inc.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- C. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: As indicated on Drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
 - b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft.
 - c. Ceiling Joist and Soffit Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
 - d. Roof Rafter Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.
 - 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
 - 4. 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 inch. Usually retain subparagraph below for exterior non-load-bearing wall framing, particularly for brick-veneer backup framing.
 - 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- D. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 - 1. Floor and Roof Systems: AISI S210.

2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

- E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
1. Grade: As required by structural performance.
 2. Coating: G60, unless otherwise specified.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: As required by structural performance.
 2. Coating: G60.

2.3 INTERIOR LOAD-BEARING WALL FRAMING (054000.A01)

- 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.
 3. Section Properties: Per SSMA.
- 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: Matching steel studs.
 2. Flange Width: 1-1/4 inches.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, 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
 3. Section Properties: Per SSMA.
- D. Vertical Deflection and Drift Clips: Manufacturer's standard bypass or 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. All Steel & Gypsum Products
 - b. Clark-Dietrich Metal Framing
 - c. MarinoWare, a division of Ware Industries
 - d. SCAFCO Corporation.
 - e. The Steel Network
- 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 loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0538 inch.
 - b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: Matching steel studs.
 - b. Flange Width: 3 inches.

- 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 through positive mechanical attachment to stud web and structure.

2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING (054000.A01)

- 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.
 - 3. Section Properties: Per SSMA.
- 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: Matching steel studs.
 - 2. Flange Width: 1-1/4 inches.
- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. 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 loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0538 inch.
 - b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
 - 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch.
 - b. Flange Width: 3 inches.
- E. 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 through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING (054000.A04)

- A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched or punched with standard holes as indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1-5/8 inches, minimum.
 - 3. Section Properties: Per SSMA.
- B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel joists.
 - 2. Flange Width: 1-1/2 inches, minimum.

2.6 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation 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 and knee braces.

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/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 55, threaded carbon-steel headless bolts, with encased end threaded, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
 1. Uses: Securing cold-formed steel framing to structure.
 2. Type: Torque-controlled adhesive anchor or adhesive anchor.
 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, 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: [ASTM A 780/A 780M] [MIL-P-21035B] [or] [SSPC-Paint 20].
- B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
- C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- D. Isolation Strip beneath Runner Tracks at Exterior Walls (054000.A08): Provide one of the following:
 1. Polyethylene-sheet backed rubberized asphalt membrane, 40 mils thick. Field cut to match widths of runners.
 2. Lamatek; 0.25 inch by 5.87 inches SCE-41 plain neoprene sponge rubber. Furnish in not less than 50 foot rolls.

2.9 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, 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 steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
 - C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable 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 steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing 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 PREPARATION

- A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.
- C. Install isolation strips beneath runner tracks at exterior walls.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 1. Screw, 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 steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- 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 equal 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 joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly 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 approved or standard punched openings.

3.4 INTERIOR LOAD-BEARING AND NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 1. Do not fasten studs to outer track of double deflection tracks.
 2. Stud Spacing: 16 inches, unless specifically indicated 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. Do not fasten studs to outer track of double deflection tracks.
 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 3. Connect vertical deflection clips to studs and anchor to building structure.
 4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated [on Shop Drawings] but not more than 48 inches apart. Fasten at each stud intersection.
 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 2. Strap 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.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 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.
- 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.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 1. Joist Spacing: As indicated.
- D. Frame openings with built-up joist headers, consisting of joist and joist track 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.
 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. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Combination 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.

3.6 ERECTION TOLERANCES

- A. Install cold-formed steel 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.

3.7 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous Steel Framing and Supports for:
 - a. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 2. Steel tube reinforcement for low partitions.
 - 3. Steel framing and supports for mechanical and electrical equipment.
 - 4. Slotted channel framing.
 - 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 - 2. Section 051200 "Structural Steel Framing."
 - 3. Section 081416 "Flush Wood Doors" for door substrate.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Paint products.
 - 2. Grout.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 2. Miscellaneous steel framing and supports.
 - 3. Steel framing and supports for mechanical and electrical equipment.
 - 4. Slotted channel framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

- D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches, unless indicated otherwise.
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum and stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.
- I. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

- E. Weld corners and seams continuously to comply with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS (055000.A01)

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 1. Fabricate units from slotted channel framing where indicated.
 2. Furnish inserts for units installed after concrete is placed.
 3. Provide steel angle supports as indicated.
 4. Galvanize miscellaneous framing and supports for exterior application and where indicated for interior applications.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer, if not exposed to view; or primer specified in Section 099600 "High-Performance Coatings" where exposed to view or painted.

2.7 MISCELLANEOUS STEEL TRIM (055000.A13)

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer, if not exposed to view; or primer specified in Section 099600 "High-Performance Coatings" where exposed to view or painted.

2.8 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer-unless zinc-rich primer is indicated or primer specified in Section 099600 "High-Performance Coatings" where exposed to view or painted.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
 - 1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking, cants, and nailers.
 - 3. Wood furring and grounds.
 - 4. Wood sleepers.
 - 5. Plywood blocking panels.
 - 6. Plywood backing panels.
 - 7. Miscellaneous framing with dimension lumber.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for those alternates affecting work of this Section.
 - 2. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - 4. Power-driven fasteners.
 - 5. Post-installed anchors.
 - 6. Metal framing anchors.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.
- A. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2[for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground].
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, roof copings, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
 - 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

- A. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

- B. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

- C. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Framing for raised platforms.
 - 2. Framing for stages.
 - 3. Concealed blocking and furring.
 - 4. Framing for non-load-bearing partitions.
 - 5. Framing for non-load-bearing exterior walls.
 - 6. Roof construction.
 - 7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING (061000.A01)

- A. Framing (061000.A01): No. 2 grade.
 - 1. Species:
 - a. Hem-fir (north); NLGA.
 - b. Mixed southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Preservative-treated blocking, grounds and nailers (061000.A12).
 - 2. Blocking, grounds and nailers (061000.A13).
 - a. Blocking for wall-mounted cabinets and casework shall be 2x6, minimum.
 - 3. Curbs and cants (061000.A14).
 - 4. Furring (061000.A15).
 - 5. Fire-retardant treated wood blocking and nailers (061000.A16).
 - 6. Fire-retardant treated wood curbs and cants (061000.A17).
 - 7. Fire-retardant treated wood furring: (061000.A18).
 - 8. Rooftop equipment bases and support curbs.
 - 9. Cants.
 - 10. Grounds.

- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
 - 1. Mixed southern pine; SPIB.
 - 2. Spruce-pine-fir; NLGA.

- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 2. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 3. Western woods; WCLIB or WWPA.
- D. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 2. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 MISCELLANEOUS PLYWOOD PANELS FOR BLOCKING

- A. General: DOC PS 1, Exposure 1, CD, non-fire-retardant treated, preservative treated, and fire-retardant treated as noted below, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness, unless specifically indicated otherwise.
 1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 2. Plywood blocking and backing panels, non-fire-retardant treated (061000.A19).
 3. Fire-Retardant-Treated Plywood blocking and backing panels (061000.A20).
 - a. Note that plywood equipment backing panels are specified in Article below.
 4. Preservative-Treated Plywood blocking (061000.A22).

2.7 PLYWOOD BACKING PANELS (061000.A20)

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.8 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- A. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.9 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets (061000.A11): Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Strip Flashing (061000.A12): Provide self-adhering, membrane, 40 mils thick.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work included, but are not limited to, the following:
 - a. Air-Shield by W. R. Meadows, Inc.
 - b. Blueskin by Henry Corp.
 - c. CCW 705 by Carlisle Coatings & Waterproofing.
 - d. Hyload S/A Through Wall Flashing by Hyload, Inc.
- C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- E. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install plywood blocking and backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Install shear wall panels to comply with manufacturer's written instructions.
- F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- L. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Fastening Tables in Section 2304 of the applicable ICC's International Building Code (IBC).
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.
- O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- A. Furring to Receive Plywood: Install 1-by-3-inch nominal-size furring vertically at 16 inches o.c.
- B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches [400 mm] o.c.

3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061063 - EXTERIOR ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood dimension lumber (061063.A01).
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for galvanized metal gate framing to receive plastic decking.

1.2 DEFINITIONS

- A. Boards: Lumber of less than 2 inches nominal in thickness and 2 inches nominal or greater in width.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Timber: Lumber of 5 inches nominal or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. SPIB: The Southern Pine Inspection Bureau.
 - 4. WCLIB: West Coast Lumber Inspection Bureau.
 - 5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Product Data: For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
- B. Samples:
 - 1. For composite plastic lumber, not less than 12 inches long, showing the range of variation to be expected in appearance, including surface texture.
 - 2. One full size sample of adjustable pedestal system with all components and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates:
 - 1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.
- C. Evaluation Reports: For the following, from ICC-ES.
 - 1. Preservative-treated wood products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Handle and store composite plastic lumber to comply with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.
 - 1. Factory mark each item with grade stamp of grading agency.
 - 2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece out of view or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 - 4. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 PRESERVATIVE TREATMENT

- A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
- B. Pressure treat timber with waterborne preservative according to AWPA U1; Use Category UC4a.
 - 1. Treatment with CCA shall include post-treatment fixation process.
- C. Pressure treat poles with waterborne preservative according to AWPA U1; Use Category UC4a.
 - 1. Treatment with CCA shall include post-treatment fixation process.
- D. Preservative Chemicals: Acceptable to authorities having jurisdiction.
 - 1. Do not use chemicals containing arsenic or chromium.
- E. Use process for boards and dimension lumber that includes water-repellent treatment.
- F. Use process for boards and dimension lumber that does not include water repellents or other substances that might interfere with application of indicated finishes.
- G. After treatment, redry dimension lumber to 19 percent maximum moisture content.
- H. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
- I. Application: Treat items indicated on Drawings.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. Use stainless steel unless otherwise indicated.
 - 2. For pressure-preservative-treated wood, use stainless-steel fasteners.
 - 3. For composite plastic lumber, use stainless-steel fasteners.
- B. Nails: ASTM F1667.
- C. Power-Driven Fasteners: ICC-ES AC70.
- D. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- E. Carbon-Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- F. Stainless-Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

- G. Postinstalled Anchors: Stainless-steel, torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing according to ASTM E488, conducted by a qualified independent testing and inspecting agency.
 - 1. Stainless-steel bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.4 METAL ACCESSORIES

- A. Stainless-Steel Sheet: ASTM A666, Type 316.
- B. Metal Accessories: Provide accessories fabricated from hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G90 coating designation.
 - 1. U-straps and plates shall be pre-drilled and fabricated from not less than 12 gauge steel, hot-dip galvanized after fabrication.
 - 2. Angle Clips for Sleepers: Provide 18 gauge, hot-dip galvanized angles 2 inches by 1.5 inches.
 - a. Basis-of-Design Product: Simpson; "A21" or comparable product.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine substrates and conditions to receive composite plastic lumber, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Clean substrates of projections and substances detrimental to application.
- B. Prime wood indicated to be painted, including both faces and edges. Cut to required lengths and prime ends. Comply with requirements in Section 099113 "Exterior Painting."

3.2 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
 - 1. Maximum allowable perpendicular overhang for decking shall not exceed 4 inches.
- B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.
 - 1. Sleepers to receive composite plastic decking shall be spaced to support decking as recommended by decking manufacturer, but no greater than 24 inches on center. Secure sleepers to substrate to prevent rotation and to maintain alignment and spacing.
- C. Install composite plastic lumber to comply with manufacturer's written instructions and in configurations indicated.
- D. Secure decking to gate framing with stainless steel fasteners. Provide two fasteners at each support member.
- E. Install metal framing anchors to comply with manufacturer's written instructions.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Apply copper naphthenate field treatment to comply with AWWA M4, to cut surfaces of preservative-treated lumber.
- J. Secure composite plastic decking to sleeper framing with stainless steel fasteners as indicated.
 - 1. Anchor sleepers to substrate utilizing angle clips spaced at 16 inches on center, staggered both sides. Secure angle clips with stainless steel fasteners.

- K. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. ICC-ES AC70 for power-driven fasteners.
 - 2. "Fastening Schedule" in ICC's International Building Code.
 - 3. "Fastener Schedule for Structural Members" and "Alternate Attachments" in ICC's International Residential Code for One- and Two-Family Dwellings.

- L. Use common wire nails unless otherwise indicated. Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

END OF SECTION 061063

SECTION 061600 – SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preservative-treated plywood sheathing (061600.A01).
2. Fire Rated plywood sheathing (061600.A02).
3. Plywood wall sheathing (061600.A03).
4. Type X glass-mat gypsum wall sheathing (061600.A04).
5. Cementitious wall sheathing (061600.A05).
6. Subflooring (061600.A11).
7. Miscellaneous sheathing as indicated for backup to sheet metal flashing, coping, and other applications indicated.
8. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.
3. Section 072729 "Fluid-Applied Air Barrier Coatings" for air barrier applied over wall sheathing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. including list of ABAA-certified installers and supervisors employed by Installer, who work on Project and testing and inspecting agency.

- B. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.
- C. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For the following, from ICC-ES:
 1. Wood-preserved-treated plywood.
 2. Fire-retardant-treated plywood.
 3. Air-barrier and water-resistant glass-mat gypsum sheathing.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.
 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
 1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, window, storefront, door frame and sill, ties and other penetrations, and flashing to demonstrate crack and joint treatment and sealing of gaps, terminations, and penetrations of air-barrier sheathing assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of sheathing before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Testing Agency Qualifications:
 1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
 2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Air-barrier and water-resistant glass-mat gypsum sheathing assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
 1. Air-Leakage-Location Testing: Mockups will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.
 2. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E783 or ASTM E2357.
 3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, tie-ins to other installed air barriers, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WOOD PANEL PRODUCTS

- A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- B. Factory mark panels to indicate compliance with applicable standard.

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2[for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground].
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat plywood indicated on Drawings, and the following:
1. Roof and wall sheathing within 48 inches (1220 mm) of fire party walls.
 2. Wall sheathing.
 3. Roof sheathing.
 4. Subflooring and underlayment for raised platforms.
 5. Back side of parapets where indicated.

2.5 WALL SHEATHING

- A. Fire Retardant Treated Plywood Wall Sheathing: (061600.A02)
1. Span Rating: Not less than 16/0.
 2. Nominal Thickness: Not less than 5/8 inch, except 3/4 inch at back sides of parapets.
 3. Size: 48 by 96 inches or as required for vertical installation without butt joints.
- B. Plywood Wall Sheathing: (061600.A03)
1. Span Rating: Not less than 16/0.
 2. Nominal Thickness: Not less than 5/8 inch.
 3. Size: 48 by 96 inches or as required for vertical installation without butt joints.
 4. Locations: Where specifically indicated.
- C. Glass-Mat Gypsum Sheathing (061600.A04): ASTM C1177/C1177M.
1. Products: Subject to compliance with requirements provide one of the following:
 - a. CertainTeed Corporation; GlasRoc.
 - b. G-P Gypsum Corporation; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond e(2)XP.
 - d. United States Gypsum Co.; Securock.
 2. Type and Thickness: Type X, 5/8 inch thick.
 3. Size: 48 by 96 inches or as required for vertical installation without butt joints.
- D. Cementitious Wall Sheathing (061600.A05): ASTM C1325, Type A.
1. Products: Subject to compliance with requirements provide one of the following:
 - a. National Gypsum; PermaBase Cement Board.
 2. Thickness: 5/8 inch (15.9 mm).

2.6 ROOF SHEATHING

- A. Plywood Roof Sheathing (061600.A06): DOC PS 1, Exposure 1 sheathing.
1. Span Rating: Not less than 24/0.
 2. Nominal Thickness: Not less than 5/8 inch.

2.7 SOFFIT SHEATHING

- A. Glass-Mat-Faced Gypsum Sheathing (061600.A04): ASTM C 1177/1177M.
 - 1. Type and Thickness: Type X, 5/8 inch thick.
 - 2. Size: 48 by 96 inches for vertical installation.

2.8 UNDERLAYMENT

- A. Underlayment (061600.A12): Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch over smooth subfloors and not less than 3/8 inch over board or uneven subfloors.
 - 1. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exterior A-C with fully sanded face.
 - 2. Plywood Underlayment for Ceramic Tile: DOC PS 1, Exterior, C-C Plugged, not less than 5/8-inch nominal thickness.
 - 3. Plywood Underlayment for Carpet: DOC PS 1, Exposure 1, Underlayment.

2.9 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. For roof, parapet, and wall sheathing, provide fasteners of Type 304 stainless steel.
 - 2. For roof, parapet, and wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.
 - 3. For roof and parapet sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
 - 4. For wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 - 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

2.10 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- B. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate wall, parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to wood framing with screws.
 - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
- C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

3.3 CEMENTITIOUS WALL SHEATHING INSTALLATION

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

- B. Testing and Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 3. Termination mastic has been applied on cut edges.
 - 4. Strips and transition strips have been firmly adhered to substrate.
 - 5. Compatible materials have been used.
 - 6. Transitions at changes in direction and structural support at gaps have been provided.
 - 7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 8. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
 - 1. Air-Leakage-Location Testing: Air-barrier sheathing assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.
 - 2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E783 or ASTM E2357.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior wood trim -Transparent (064023.A01).
 - 2. Custom plastic laminated clad casework (064023.A16).
 - 3. Display hanging systems (064023.A27).
 - 4. Reclaimed wood (064023.A35).

- B. Related Sections include the following:
 - 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
 - 2. Section 062023 "Interior Finish Carpentry" for premanufactured wood trim and shelving.
 - 3. Section 123200 "Manufactured Wood Casework" for premanufactured casework.

1.2 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

- B. Balanced Construction: Where exposed face of a panel is surfaced with high pressure plastic laminate and the opposite (back) surface shall receive a cabinet liner or backer sheet when that surface is not exposed to view. All countertops shall have backer sheets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including hardware, accessories and solid-surfacing material.

- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.
 - 4. Indicate anchorage for wall hanging and ceiling mounted shelving. Contractor shall coordinate all anchorage requirements for shelving and casework with field conditions during construction.

- C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

- D. Samples for Verification:
 - 1. For each species and cut of lumber and wood trim with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. for lumber and 10 inch long for trim, including railing cap.
 - 2. Veneer-faced panel products with transparent finish, with 1/2 of exposed surface finished, 8 by 10 inches for each species and cut of veneered panel. Include at least one face-veneer seam and finish as specified.
 - 3. Plastic laminate-faced panel products, 8 by 10 inches for each color of plastic laminate panel. Include at two edges with specified edging.
 - 4. Plastic laminates, 8 by 10 inches, for each color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - 5. Plastic laminate-clad countertop with 3mm PVC edging, sample not less than 8 inches square with edging on one side.
 - 6. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
 - 7. Exposed cabinet hardware and accessories, one unit for each type.
 - 8. Solid-surfacing materials, 6 inches square.
 - 9. Wood Wall Panel system materials, 2 samples in unit size specified of 2 ft lengths. Include sample of edging system specified.
 - 10. Display case hanging shelving system, not less than one sample of each component and 12 inch long sample of cable.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of product, signed by product manufacturer.
- B. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance of not less than seven years under the current company name.
- B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers and plastic laminate finishes.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - 1. Comply with "Custom" grading requirements, unless specifically specified otherwise.
- E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- F. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.
- B. Stack lumber, trim, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- C. Package doors with markerboard laminated face individually to prevent damage to the doors and the finish.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install interior architectural woodwork materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: To match 062023.A10
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
- D. Plastic-Laminate-Clad Panels: Particleboard or medium-density fiberboard core, $\frac{3}{4}$ inch thick, finished with plastic laminate, grade VGS in color as selected by Architect. Each panel shall be self-edged. Back panel face (non-exposed) to receive grade BKL backing sheet.
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Basis of Design Products: Subject to compliance with requirements, provide products by manufacturers indicated on Material Finish Legend on drawings or comparable product submitted to and accepted by Architect prior to bidding.
 - 2. Colors and Patterns: As indicated Material Finish Legend on Drawings.
- F. Concealed Countertop Bracket (064023.A32) – Basis-of-Design Product: Subject to compliance with requirements, provide A&M Hardware, Inc.; "Concealed Bracket, C (2.0)" without upper extension. Length of support arm varies, refer to Drawings. Color to be selected by Architect from manufacturer's full range of colors. Final color as indicated on drawings. Carrying capacity shall not be less than 450 lbs, accommodating a counter depth of at least 25 inches. Comparable products will be considered when submitted to and accepted by Architect prior to bidding.
 - 1. Coordinate solid wood blocking requirements for a concealed bracket installation prior to installation of drywall.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified.
 - 1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.
 - 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWWA C20 (lumber) and AWWA C27 (plywood). Use the following treatment type:
1. Interior Type A: Low-hygroscopic formulation.
 2. Kiln-dry materials before and after treatment to levels required for untreated materials.

2.3 INTERIOR TRIM ACCESSORY (062023.A02)

- A. Metal Edge/Transition Strip:
- a. Basis of Design: Schluter "Quadec" or a comparable product meeting specified requirements, having similar finish as acceptable to Architect with the following characteristics submitted to and accepted by Architect prior to bidding.
 - 1) Finish: Satin Anodized Aluminum.
 - 2) Size: ½"

2.4 PANELING

- A. Board Paneling (064023.A35): Interior wood-board paneling as follows:
1. General: Material Finish Schedule designation "WD1".
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Terra Mai; "Lost Cost Redwood", tongue and groove, with 1/16 inch beveled edge profile.
 - b. Species: Reclaimed Sequoia sempervirens.
 - 1) Texture Finish: As selected by Architect from manufacturer's full range of options.
 - c. Colors: Refer to Material Finish Legend.
 - d. Width: Not less than 5 inches.
 - e. Thickness: ½ inch.
 - f. Board Lengths: Random. At door cladding minimum should be the width of the door.

2.5 INTERIOR WOOD TRIM AND MOLDINGS – TRANSPARENT (064023.A01)

- A. Hardwood Lumber Trim for Transparent Finish: Comply with AWI, Section 300, Grade "Custom".
1. Species and Grade: Match existing, as approved by the architect.
 2. Maximum Moisture Content: 13 percent.
 3. Finger Jointing: Not allowed.
 4. Gluing for Width: Use for lumber trim wider than 6 inches.
 5. Veneered Material: Not allowed.
 6. Face Surface: Surfaced (smooth).
 7. Matching: Selected for compatible grain and color.
 8. Profiles: Refer to Drawings for configurations and profiles required.
- B. Hardwood Moldings for Transparent Finish: WMMPA HWM 2, N-grade wood moldings made to patterns included in WMMPA HWM 1.
1. Species: Match existing, as approved by the architect.
 2. Maximum Moisture Content: 9 percent.
 3. Finger Jointing: Not allowed.
 4. Matching: Selected for compatible grain and color.
 5. Profiles: Refer to Drawings for configurations and profiles required.

2.6 CUSTOM PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS (064023.A16)

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
- B. Cabinet Materials:
1. Exposed Cabinet Materials:
 - a. Plastic Laminate: Grade VGS.
 - b. Unless otherwise indicated, provide specified edge banding on all exposed edges.
 2. Semiexposed Cabinet Materials:
 - a. Plastic Laminate: Grade VGS.
 - 1) Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.
 - b. Metal for Steel Drawer Pans: Cold-rolled, steel sheet.

- c. Unless otherwise indicated, provide specified edge banding on all semi-exposed edges.
 - 3. Concealed Cabinet Materials:
 - a. Plastic Laminate: Grade BKL.
- C. Design, Color and Finish:
 - 1. Design: Flush overlay with wire pulls.
 - 2. Plastic-Laminate Colors, Patterns, and Finishes:
 - a. Plastic Laminate: PL1.
 - b. Basis of Design: Wilsonart "Carbon Mesh" or approved equal.
 - 3. As indicated by manufacturer's designations on Drawings.
 - 4. Thermoset Decorative Panel Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range.
 - 5. PVC Edgebanding Color: As indicated by manufacturer's designation on Material Finish Legend.
 - 6. Hardwood Edgebanding Color: Where indicated on drawings, provide hardwood edgebanding of species and cut as selected by Architect from manufacturer's full range.
- D. Cabinet Fabrication: Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:
 - 1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.
 - 2. Shelves: 1-inch thick, thermoset decorative panels.
 - 3. Backs of Cabinets: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.
 - 4. Drawer Fronts: 3/4-inch particleboard, plastic-laminate faced exposed face and balanced backer.
 - 5. Drawer Sides and Backs:
 - a. 1/2-inch solid-wood or veneer-core hardwood plywood, with glued dovetail or multiple-dowel joints.
 - b. 1/2-inch, high density fiberboard, 55 pcf density minimum. All parts glued and mechanically fastened using thermosetting fasteners.
 - c. 1/2-inch, high density melamine composite panels. All parts glued and mechanically fastened using thermosetting fasteners.
 - 6. Drawer Bottoms: 1/4-inch thermoset decorative panels glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
 - 7. Doors: 3/4-inch particleboard or MDF, plastic-laminate faced.
 - 8. Cabinets Bases: Bases shall be fabricated separate from cabinets (not integral). Fabricate from 3/4-inch exterior grade, preservative treated plywood or preservative-treated 2x4's. Fabricate in a ladder configuration with plywood fronts and back running continuous for the length of the cabinet. Provide ends, and provide additional runners centered in all cabinets greater than 24 inches wide.
 - 9. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.7 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."
- B. Frameless Concealed Hinges (European Type): Provide "Clip top Blumotion" hinges from Blum. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.
 - 1. Location: Provide at all custom casework pieces.
- C. Pulls: Solid aluminum, fastened from back with two screws. Provide 2 pulls for drawers more than 24 inches wide.
 - 1. Basis of Design: Hafele 106.74.901.
 - 2. Finish: 106AL69
- D. File and Flat-File Drawer
- E. Drawer Slides: BHMA A156.9, Type B05091.
 - 1. Standard Duty (Grades 1, 2, and 3): Side mounted and extending under bottom edge of drawer; full - extension type; zinc-plated steel with polymer rollers.
 - 2. Box Drawer Slides: Grade 1, for drawers not more than 6 inches high and 24 inches wide.
 - 3. File and Flat-File Drawer Slides: Grade 1HD-100, for drawers more than 6 inches high or 24 inches wide.
- F. Adjustable Shelf Supports: 2-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013.
 - 1. Adjustable shelf standards and brackets for glass shelves at display cases are specified in Section 088000.

- G. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: Where not otherwise specified, provide BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- H. Drawer and Hinged Door Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
 - 1. Provide a minimum of two keys per lock and six master keys.
 - 2. Provide locks at all cabinets, all keyed alike.
- I. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- J. Grommets (064023.A22)
 - 1. Cable Passage through Grommet for Countertops: 2-1/2-inch OD, molded-plastic grommet with flip top cap with slot for wire passage and matching plastic sleeve. Color as selected by Architect.
 - a. Basis-of-Design Product: Doug Mockett and Company, Inc.; Model EDP3.
 - 2. Laminate Grommet Cap Cover: For cable passage through countertops, 3-inch OD, trim ring and liner shall be matte black, molded-plastic grommets. Cap to receive laminate with slot for wire passage.
 - a. Basis-of-Design; Doug Mockett "LG3-90."

2.8 HANGING DISPLAY SYSTEM (064023.A27)

- A. Hanging Display System: Subject to compliance with requirements, provide the following hanging display system, including all accessories and fasteners, or comparable products from other manufacturers, submitted to and accepted by Architect prior to bidding.
 - 1. Hanging Display System:
 - a. Basis-of-Design Product: Arakawa Hanging Systems.
 - b. Gripper: As required for attachment.
 - c. Cable: Provide manufacturer's standard 1/8 inch diameter, stainless steel air craft cable. Capable of a 65 lbs maximum load carrying capacity with Loop.

2.9 SOLID-SURFACING-MATERIAL COUNTERTOPS (06423.A19)

- A. General: Material Color Schedule designation "SS".
- B. Grade: Premium.
- C. Solid-Surfacing-Material Thickness: 1/2 inch.
- D. Colors, Patterns, and Finishes: Counter tops, splashes, aprons and undercounter panels shall be of the same material and color. Architect may select a separate color for each room. Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:
 - 1. Basis of Design: Refer to the Material Finish Legend.
 - 2. As indicated by manufacturer's designations indicated on Material Finish Legend
- E. Fasteners: Provide non-corrosive fasteners as required for complete installation of components and assemblies. Type and size shall be as required for conditions, materials and superimposed loads involved.
- F. Accessories: Comply with manufacturer's recommendations for hardware, non-corrosive fasteners, adhesives, sealers, fabrication and finishing. Refer to Section 123661 "Simulated Stone Countertops" for support bracket.
- G. Fabricate in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with shop-applied edges of materials and configuration indicated.
 - 2. Sinks fabricated from the same solid surfacing materials as the tops unless otherwise indicated.
 - 3. Fabrication shall be in accordance with approved shop drawings and solid polymer manufacturer's requirements.
 - 4. Rout and finish component edges to a smooth and uniform finish. Rout all cutouts, then sand all edges smooth. Repair or re-fabricate defective work and inaccurate work as determined by the architect.

2.10 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.11 FABRICATION, GENERAL

- A. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
 - 2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - 2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of openings in countertops with a coat of varnish.
- E. Back out or kerf backs of the following members except those with ends exposed in finished work:
 - 1. Interior standing and running trim except shoe and crown molds.
 - 2. Wood-board paneling.
- F. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

2.12 SOLID SURFACING FABRICATION

- A. General: Fabricate from 1/2" thick solid polymer material complete with integral under-mount ADA compliant sinks. Each countertop shall receive loose backsplashes and endsplashes. Provide endsplashes at all locations where counter top abuts adjacent wall. Material shall be attached to the countertop deck and wall with color coordinated adhesive sealant on site.
- B. Fabricate components in shop to greatest extent practical to sizes, shapes and configurations indicated. Fabrication shall be in accordance with approved shop drawings and solid polymer manufacturer's requirements.
- C. Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach a 2" wide reinforcing strip of solid polymer material under each joint.
 - 1. Provide cutouts and holes for plumbing and bath accessories.
- D. Rout and finish component edges to a smooth and uniform finish. Rout all cutouts, then sand all edges smooth. Chamfer edge at sink to countertop connection. Repair or re-fabricate defective and inaccurate work as determined by the Architect.
- E. Edge Treatment: Edge treatment shall be 1 1/2" double-radiused edge or bullnose edge, refer to drawings.
- F. Adhesives shall create inconspicuous, non-porous joints with chemical bond.
 - 1. Apply 45 degree chamfer to inside perimeter of sinks to conceal sink to countertop joint.

- G. Finish: All surfaces shall have a uniform matte finish (gloss rating of 5 - 20).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine all areas and conditions where solid surfacing fabrications will be installed. Notify Architect of any conditions that would adversely affect the installation. Do not proceed with installation until unsatisfactory conditions are corrected.
1. Commencement of installation is construed as acceptance of the adjacent surfaces and conditions.

3.2 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.3 INSTALLATION

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.
- B. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- C. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Ornamental Woodwork: Install without distortion so units fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Maintain veneer sequence matching of units with transparent finish.
- D. Custom Casework - General: Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
1. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
 - a. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
 2. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
 - a. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c.
 - b. Use toggle bolts at hollow masonry.
 - c. Use expansion anchors at solid masonry.
 - d. Use No. 10 wafer-head screws sized for 1-inch penetration into wood blocking.

- e. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish at metal-framed partitions.
 - 3. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
 - 4. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop. Set sills in manufacturer's recommended adhesive.
- 1. Align adjacent solid-surfacing-material sills and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Calk space between sill and wall/adjacent construction with sealant specified in Division 07 Section "Joint Sealants."
- F. Install flush wood doors with marker board laminate on sliding door hardware specified in Section 087100. Doors shall be plumb and level and operate smoothly, as acceptable to Architect.

3.4 SOLID SURFACING FABRICATION

- A. General: Fabricate from 1/2" thick solid polymer material complete with integral under-mount ADA compliant sinks. Each countertop shall receive loose backsplashes and endsplashes. Provide endsplashes at all locations where counter top abuts adjacent wall. Material shall be attached to the countertop deck and wall with color coordinated adhesive sealant on site.
- B. Fabricate components in shop to greatest extent practical to sizes, shapes and configurations indicated. Fabrication shall be in accordance with approved shop drawings and solid polymer manufacturer's requirements.
- C. Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach a 2" wide reinforcing strip of solid polymer material under each joint.
 - 1. Provide cutouts and holes for plumbing and bath accessories.
- D. Rout and finish component edges to a smooth and uniform finish. Rout all cutouts, then sand all edges smooth. Chamfer edge at sink to countertop connection. Repair or re-fabricate defective and inaccurate work as determined by the Architect.
- E. Edge Treatment: Edge treatment shall be 1 1/2" double-radiused edge or bullnose edge, refer to drawings.
- F. Adhesives shall create inconspicuous, non-porous joints with chemical bond.
 - 1. Apply 45 degree chamfer to inside perimeter of sinks to conceal sink to countertop joint.
- G. Finish: All surfaces shall have a uniform matte finish (gloss rating of 5 - 20).

3.5 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 - 2. Install trim after gypsum-board joint finishing operations are completed.
 - 3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.6 PANELING INSTALLATION

- A. Board Paneling: Install according to manufacturer's written instructions.
 - 1. Install in full lengths without end joints to best extent possible.
 - 2. At Commons, stagger end joints in random pattern to uniformly distribute joints on each wall.

3. Install with uniform end joints. Locate end joints only over furring or blocking.
4. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards. Install with uniform tight joints between boards.
5. Fasten paneling by blind nailing through tongues to best extent possible, where not possible fasten paneling by face nailing, setting nails, and filling over nail heads.
6. Fasten paneling to gypsum wallboard with panel adhesive.

3.7 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.
- D. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

END OF SECTION 064023

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cold-applied, emulsified-asphalt dampproofing (071113.A01).
- B. Related Requirements:
 - 1. Section 071326 "Self-Adhering Sheet Waterproofing" for self adhering sheet waterproofing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course and auxiliary materials recommended in writing by manufacturer of primary materials.
- B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING (071113.A01)

- A. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1 for vertical surfaces.
- B. Brush and Spray Coats: ASTM D 1227, Type III, Class 1 for horizontal surfaces.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Patching Compound: Epoxy or latex-modified repair mortar, or asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.

- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing is indicated, apply across top of trench footings (grade beams) and at other locations indicated.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Foundations and Trench Footings (Grade Beams) Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or one fibered brush or spray coat at not less than 3 gal./100 sq. ft.
 - 1. Omit dampproofing over tops of foundations, strip footings (grade beams) indicated to receive cold fluid-applied waterproofing.

3.5 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board (XPS) (072100.A01).
2. Extruded Polystyrene Foundation Perimeter Insulation (072100.A01)
 - a. Refer to Section 033000 for installation and product information.
3. Polyisocyanurate foam-plastic board (072100.A04).
4. Glass-fiber board (072100.A05).
5. Glass-fiber blanket (072100.A08).
6. Mineral-wool blanket (072100.A17).
7. Spray polyurethane foam insulation (072100.A12).

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for foundation insulation and foam void fill.
2. Section 071416 "Cold Fluid-Applied Waterproofing" for insulating protection board/drainage panels.
3. Section 072763 "Spray-Applied Insulating Foam Air Barrier System".
4. Division 7 Roofing Sections for insulation specified as part of roofing construction.
5. Section 078446 "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
6. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.5 PERFORMANCE CRITERIA

- A. Foam insulation use in an exterior continuous insulation application must comply with Chapter 26 of the International Building Code, current edition as adopted by authority having jurisdiction. The "Code" requires an NFPA 285 test of the entire assembly, inclusive of each proprietary material used within the wall assembly. No substitutions for materials are allowed without retesting of that entire wall assembly.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV (072100.A01): ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board, Glass-Fiber-Mat Faced (072100.A04): ASTM C 1289, glass-fiber-mat faced, Type II, Class 2, Grade 2. Facers shall be coated.
 - 1. Locations:
 - a. Cavity wall insulation
 - b. At Kitchen refrigerator/freezer beneath slab.
 - 2. Thicknesses:
 - a. Cavity wall applications, 3 inches thick, unless otherwise indicated.
 - b. Behind metal wall panels, 3 inches, unless otherwise indicated.
 - c. At Kitchen refrigerator/freezer, provide an overall thickness of at least 6 inches. First layer shall be 1-1/2 inches thick.
 - 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - 4. Insulation, associated components and adhesives shall be compatible with fluid-applied air barrier coating specified in Section 072729.
 - 5. Manufacturers and Products: Subject to compliance with requirements, provide one of the following products:
 - a. Carlisle Coatings and Waterproofing; "R2+ Matte."
 - b. Firestone Building Products; "Enverge CI."
 - c. Hunter; "Xci CG".
 - d. Atlas; comparable product submitted to and accepted by Architect prior to bidding.

2.3 GLASS-FIBER BOARD INSULATION

- A. Glass-Fiber Board Insulation (072100.A05): ASTM C 612, Type IA; unfaced, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.
 - 2. Thickness: As indicated.

2.4 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced (072100.A08): ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Thickness: As indicated.

2.5 MINERAL-WOOL INSULATION

- A. Mineral-Wool Blanket, Unfaced (072100.A17): ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Thickness: As indicated.
- B. Pre-manufactured Head-of-Wall Mineral Wool Insulation: Meeting same criteria as specified above; manufactured into various shapes and sizes to fill voids between top-of-wall and metal decking.

2.6 SPRAY POLYURETHANE FOAM INSULATION

- A. Closed-Cell Polyurethane Foam Insulation (072100.A12): ASTM C1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450 respectively, per ASTM E84.
 - 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. BASF Corporation
 - b. Dow Chemical Company (The)
 - c. NCFI; Division of Barnhardt Mfg. Co.
 - d. Icynene "ProSeal".
 - 2. Minimum density of 1.5 lb/cu. ft., thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg. F.

2.7 ACCESSORIES

- A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
 - 1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
 - 2. Adhesives shall be compatible with fluid-applied air barrier coating specified in Section 072729.
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement. Seal/tape all joints in polyisocyanurate insulation on exterior face.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On horizontal surfaces, loosely lay insulation units in two layers, according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. At Kitchen refrigerator/freezer, install as indicated.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer

- C. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

- D. Mineral-Wool Blanket Insulation: Install at tops of non-rated interior walls to fill cavities between top of wall and underside of deck/structure above. Install in parapet walls over runner track as shown. Provide lengths that will produce a snug fit between ends.

- E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

- F. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of CMU by using method recommended by insulation manufacturer.
 - 1. Fill voids of joist bearing pockets in exterior walls.
 - 2. Fill voids between double studs at openings in exterior walls.
 - 3. Fill voids between framing members of boxed headers, including header.
 - 4. Fill voids at tops of exterior walls or provide pre-manufactured head-of-wall mineral wool insulation.
 - 5. At raised Platform between framing members for sound deadening.

3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Self-adhering building wrap/weather barrier.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For self-adhering building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.
- B. Shop Drawings: For weather-barrier assemblies.
 - 1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier, from ICC-ES.
 - 1. Weather resistive barrier shall meet ICC-ES AC308 "Acceptance Criteria for Water Resistive Barriers".

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER (072500.A02)

- A. Basis-of-Design Products: Provide weather resistive barrier as a complete system, including but not limited to; self-adhering building wrap, self-adhering flashing, reinforced liquid flashing, tape and sealants. Subject to compliance with requirements, provide one of the following:
 - 1. VaproShield LLC; "VaproShield WrapShield SA".
 - 2. Henry Company; "BlueskinVP 160".
 - 3. Cosella-Dorcken; "Delta-Vent SA".
 - 4. Comparable substitute meeting specified requirements, and which is submitted to and accepted by Architect prior to bidding.
- B. Performance Characteristics:
 - 1. Water-Vapor Permeance: Not less than 29 perms per ASTM E 96/E 96M, Method B.
 - 2. Air Leakage: Not greater than 0.004 CFM/sqft at 1.57 lbs/sqft when tested in accordance with ASTM E2178.
 - 3. Thickness shall not be less than 0.026 inches.
 - 4. Allowable UV Exposure Time: Not less than three months.
 - 5. Fire Performance Characteristics: Class A when tested in accordance with ASTM E 84.

2.2 MISCELLANEOUS MATERIALS

- A. General: Accessory materials recommended by weather-barrier manufacturer to produce a complete assembly and compatible with primary weather-barrier material
- B. Flexible Flashing: Weather resistive barrier manufacturer's standard composite, self-adhesive, flashing product.
- C. Liquid Flashing: Weather resistive barrier manufacturer's standard composite, liquid flashing and reinforcing mesh.
- D. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- E. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 EXAMINATION AND SURFACE PREPARATION

- A. General: Examine and prepare surfaces to receive self-adhering building wrap/weather barrier in strict accordance with barrier manufacturer's written instructions, and as follows:
 - 1. All surfaces must be dry, sound, clean and free of oil, grease, dirt, excess mortar and other contaminants detrimental to adhesion of barrier membrane and flashings.
 - 2. Remove fins, ridges, mortar, and other projections.
 - 3. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.2 WATER-RESISTIVE BARRIER INSTALLATION

- A. General: Install weather-barrier and accessory materials according to manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous weather barrier.
 - 1. Apply flashing (liquid and membrane types) to comply with manufacturer's written instructions.
- B. Where recommended by weather barrier manufacturer, apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 1. Cover exposed exterior surface of sheathing indicated to receive metal roof panels with water-resistive barrier securely adhered to sheathing as occurs. Stagger all end lap seams.
- C. Cover sheathing with water-resistive barrier as follows:
 - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
 - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap.
 - 3. Lap over adjacent construction and adhere to substrate. Cut back weather resistive barrier so it will not be exposed to view and will allow for edge of barrier to be covered with sealant.
- D. At end of each working day, seal top edge of weather barrier to substrate with termination mastic.
- E. Openings: Prime concealed, perimeter of all openings. Apply transitions and flashing (liquid or membrane) so that a minimum of 3 inches of coverage is achieved over each substrate.
- F. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- G. Repair punctures, voids, and deficient lapped seams. Slit and flatten fishmouths and blisters. Extend patches 6 inches beyond repaired areas.
- H. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

END OF SECTION 072500

SECTION 072729 - FLUID-APPLIED AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Fluid-applied, vapor-retarding membrane air barriers (072729.A01).
- B. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for masonry to receive air barriers.
 - 2. Section 061600 "Sheathing" for wall sheathing to receive air barriers.

1.2 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PREINSTALLATION MEETINGS

- A. Pre-Installation Conference: Conduct conference at Project site.
 - 1. Contractor to organize and convene conference a minimum of two weeks prior to commencing Work of this Section.
 - 2. Agenda shall include, at a minimum, construction and visual inspection of mock-up, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Construction site safety will be discussed to review hazards or fire risks during application.
 - 3. Attendance is required by air barrier coating manufacturer's representative, air barrier coating installer, representatives of related trades including covering materials, substrate materials and adjacent materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; tested physical and performance properties of products.
 - 2. Include verification data, including graphic illustrations, listing each component of the assembly passing NFPA 285 testing.
 - 3. Submit product data for air barrier coatings concurrently with product data for polyisocyanurate insulation.
- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier. Include details for each type of substrate showing: substrate joints and cracks, through-wall flashing, counterflashing, each type of penetration, inside and outside corners, terminations, expansion joints, air barrier flashing system at openings and tie-ins with adjoining construction.
 - 2. Include details of interfaces with other materials that form part of air barrier.
 - 3. Show and list each component of the assembly.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer. Include list of manufacturer-certified installers and supervisors employed by the Installer, who work on Project, in addition to the following:
 - 1. Submit in writing, evidence of experience.
 - 2. Submit evidence of current certification and training from fluid-applied air barrier manufacturer. When air barrier manufacturer does not certify installer, submit evidence of accreditation and certification under the Air Barrier Association of America's (ABAA) Quality Assurance Program. Submit accreditation number of manufacturer and certification number of each installer.

- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.
- C. Product test reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer, in addition to the following:
 - 1. Installer shall have not less than 5 years successful experience, under the current company name, in installing fluid-applied membrane air barriers of similar type, size and complexity as those specified for this Project.
 - 2. Installer shall submit a reference list, complete with Owner, Architect, General Contractor or Construction Manager; phone number of each, of at least seven (7) completed projects in the states of Missouri and Kansas similar in size and specification.
 - a. List shall include square footage installed on each project.
 - b. List shall include type of air barrier installed, name of product installed and name of manufacturer.
 - 3. Installer shall assign experienced mechanics from previous applications, including lead mechanic/supervisor, for this Project.
- B. Field Mockups: Build integral field mockup to set quality standards for materials and execution.
 - 1. Apply air barrier coating to wall areas as directed by Architect, to demonstrate surface preparation, crack and joint treatment, application of air barriers and associated flashing and transitions, and sealing of gaps, terminations, ties-ins and terminations at openings, and penetrations of air-barrier assembly.
 - 2. Each wall sheathing areas shall not be less than 100 sq ft.
 - 3. Coordinate application to mockups to permit inspection by Architect and air barrier coating manufacturer's representative of air barrier before external insulation and cladding are installed.
 - a. Include junction building corner condition, building expansion joint and sheet metal flashing.
 - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.
 - 3. Do not apply product or accessories over incompatible materials.

PART 2 - PRODUCTS

2.1 MATERIALS – GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
 - 1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 PERFORMANCE REQUIREMENTS

- A. Vapor Retarding Air Barrier - General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate

expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.
- C. Exterior wall assemblies incorporating the product and accessories shall be tested in accordance with and comply with the acceptance criteria of NFPA 285.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

- A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier (072729.A01): Fire-resistant, synthetic polymer membrane.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Carlisle Coatings and Waterproofing (CCW); "Fire-Resist BarriTech NP."
 - b. Henry Corporation; "Air-Bloc 32 MR."
 - c. Tremco Inc.; "ExoAir 130".
 - d. W. R. Meadows; "Air-Shield LSR."
 - e. Comparable products from other manufacturers meeting specified requirements, and that are submitted to and accepted by Architect prior to bidding.
 - 2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Water Vapor Permeance: Maximum 1 perm; ASTM E 96/E 96M (Method B).
 - c. Ultimate Elongation: Minimum 346 percent; ASTM D412, Die C.
 - d. Surface Burning Characteristics:
 - 1) Flame Spread Index of 25 or less; ASTM E 84.
 - 2) Smoke Generation Index of 450 or less; ASTM E 84.
 - e. Low Temperature Flexibility: No cracking at minus 20 degrees F, 180 degree bend over 1-inch mandrel.
 - f. Fastener Sealability: No water leaking through nail penetration after 24 hours; ASTM D 1970.
 - g. UV Exposure Rating: Coating may be exposed up to 180 days (6 months) without effecting warranty.
 - h. Multi-Story Fire Tests: Air barrier coating shall pass NFPA 285.

2.4 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete fire-resistant air-barrier assembly and compatible with primary air-barrier material.
- B. Transition Membrane and Flashing (072729.A03): Provide self-adhering sheet or reinforced liquid flashing as recommended by air-barrier material manufacturer. Approved with air barrier membrane in NFPA 285 wall assemblies.
 - 1. Basis-of-Design Products for Transition Membrane: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings and Waterproofing; "CCW Sure-Seal Pressure-Sensitive Elatoform".
 - b. Comparable products from other manufacturers listed.
 - c. Comparable products from other manufacturers not listed, meeting specified requirements, submitted to and accepted by Architect prior to bidding.
 - 2. Basis-of-Design Products for Detail Flashing: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings and Waterproofing; "Fire-Resist 705 FR-A."
 - b. Comparable products from other manufacturers listed.
 - c. Comparable products from other manufacturers not listed, meeting specified requirements, submitted to and accepted by Architect prior to bidding.
- C. Contact Adhesive: As approved by air-barrier manufacturer.
- D. Primer: Liquid primer as approved by air-barrier manufacturer for substrates involved.
- E. Detail Mastic: As approved by air-barrier manufacturer.
- F. Joint Reinforcing Fabric: Air-barrier manufacturer's woven, synthetic polymer reinforcement fabric.

- G. Joint Reinforcing Strip: Air-barrier manufacturer's self-adhering glass-fiber-mesh tape.
- H. Glass Mat: Randomly-oriented glass strands held in binder soluble in wet air barrier membrane.
 - 1. As approved by air-barrier manufacturer.
- I. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- J. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
- K. Sprayed Polyurethane Foam Sealant: Class 1, one- or two-component, disposable, closed-cell, low-pressure spray foam insulation/sealant kits. Spray foam shall be flame retardant and have a nominal 2.0-lb/cu. ft density; 95 percent minimum closed cell content and shall meet ASTM E 84 requirements flame-spread index of 25 or less and a smoke developed rating of 300 or less based on 2 inch thickness. Provide insulation manufacturer's recommended primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- L. Joint Sealant:
 - 1. Dow 790, 791, 795.
 - 2. Pecora 890, 891, 895.
 - 3. GE Silpruf, Silpruf LM.
 - 4. Other product approved by air barrier membrane manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263. Honeycomb and holes/cracks exceeding ¼ inch across shall be filled with grout or mortar.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
 - 5. Verify that wall assemblies are dried in, such that water intrusion will not occur from above, behind or around the air barrier installation.
 - 6. Surfaces shall be supported and flush at joints without large voids or sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate and substrate joints according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. Fill cracks, gaps and joints exceeding ¼ inch width with fill compound or sealant approved by air barrier manufacturer. Fill rough gaps around pipe, conduit and similar penetrations with mortar, non-shrink grout, fill compound or polyurethane foam sealant shaved flush.
- G. At changes in substrate plane, apply sealant or termination mastic beads to create a cant at sharp corners and edges

to form a smooth transition from one plane to another.

- H. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air-barrier coating material and embed joint reinforcing in preparation coat.
- B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of air-barrier coating material at joints. Tape joints with joint reinforcing after first layer is dry. Apply a second layer of air-barrier coating material over joint reinforcing.
- C. Plywood Sheathing: Fill joints and apply air-barrier coating in strict accordance with air-barrier coating manufacturer's written instructions to suit substrate involved.

3.4 TRANSITION STRIP AND FLASHING INSTALLATION

- A. General: Install strips, transition strips, flashing, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of sheet metal flashing and embedded masonry through-wall flashing to ensure continuity of air barrier and drainage to exterior.
 - 2. Install transition strip between changes in substrates and base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- B. Apply primer to substrates, when required by air barrier coating manufacturer, at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier coating material on same day. Re-prime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum and plywood sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
 - 2. Where required by air barrier coating manufacturer to achieve performance specified, apply manufacturer's recommended filler coat over CMU and similar substrates.
- C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials. Extend flashing/transition membrane into window and other openings to completely cover wood blocking and nailers in accordance with air barrier coating manufacturer's recommendations and approved shop drawings.
- D. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- E. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- F. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- H. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 INSTALLATION

- A. General: Install fluid-applied membrane air-barriers and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier/moisture barrier. Apply air-barrier coating within manufacturer's recommended application temperature ranges.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier.
 - 2. Coordinate the installation of air barrier with installation of weather barrier and jamb closure membranes to ensure compatibility and continuation of barriers to allow water to drain to exterior.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Vapor Retarding Fluid-Applied Membrane Material: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
 - 1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by air barrier manufacturer to meet performance requirements specified and as listed in Air Barrier Association of America (ABAA) for air permeance and water vapor permeance (desiccant method), but not less than 40-mil dry film thickness.
 - a. Apply additional coats as needed to achieve void- and pinhole-free surface.
 - 2. Extend system into window and door openings of metal-stud-framed walls.
- D. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.
- E. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- F. Repair punctures, voids, and deficient lapped seams. Slit and flatten fishmouths and blisters. Extend patches 6 inches beyond repaired areas, unless otherwise recommended by air barrier manufacturer.
- G. Do not cover air barrier until it has been inspected by air barrier coating manufacturer's representative and installation has been reviewed and accepted by Architect.
- H. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Air barrier coating manufacturer shall perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include, and is not limited to, the following:
 - 1. Continuity of air-barrier system has been achieved with no gaps or holes.
 - 2. Continuous support of air-barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 4. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 5. Surfaces have been primed, if applicable.
 - 6. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 7. Termination mastic has been applied on cut edges.
 - 8. Flashing strips, transition strips and liquid flashing have been firmly adhered to substrate.
 - 9. Compatible materials have been used.
 - 10. Transitions at changes in direction and structural support at gaps have been provided.
 - 11. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 12. All penetrations have been sealed.

- C. Tests: As determined by air barrier coating manufacturer's representative from among the following tests:
 - 1. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 16 lbf/sq. in. according to ASTM D 4541 for each 1000 sq. ft. of installed air barrier or part thereof.
 - D. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 - 2. Remove and replace deficient air-barrier components for retesting as specified above.
 - E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- 3.7 CLEANING AND PROTECTION
- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
 - 1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
 - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
 - B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
 - C. Remove masking materials after installation.

END OF SECTION 072729

SECTION 074113 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Standing-seam metal roof panels.
- B. Related Sections:
 - 1. Section 061600 "Sheathing" for plywood roof sheathing to receive metal roofing.
 - 2. Section 072100 "Thermal Insulation" for roofing insulation below sheathing.
 - 3. Section 074213 "Metal Wall and Soffit Panels" for metal panels used in vertical and horizontal applications.
- C. Materials Furnished but not Installed Under this Section:
 - 1. Pre-finished coil-coated galvanized steel stock to sheet metal fabricator (refer to Section 076200), to allow for the fabrication of miscellaneous fascia and trim. Intent is to have miscellaneous fascia and trim color and base metal material match that of the metal roofing.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and other installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels. Review video platform "crow's nest" details and flashing.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal panel systems during and after installation.
 - 8. Review procedures for repair of metal panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
 - 3. .
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim, flashing and accessories involving color selection.

- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.
- E. Test Reports: For each area indicated to receive metal roofing, submit pull-out test reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Mockups: Build integrated field mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups for typical roof area, including gutter and other accessories.
 - a. Size: 12 feet long by 6 feet.
 - b. Each type of exposed seam and seam termination.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Five (5) years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: Twenty (20) years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. Warranty Period: Twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for steep-slope roof products.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than $l/180$ of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft., minimum.
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- F. Fire Rating: Provide metal roof system and component materials that comply with requirements for a UL Class A rated assembly when tested in accordance with UL 263 and UL 790.

- G. Hail Rating: Provide metal roof system and component materials that comply with requirements for a UL Class 4 rated assembly when tested in accordance with UL 2218.
- H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
- B. Integral-Standing-Seam Metal Roof Panels (074113.A01): Formed with integral vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs or pan with striations between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide; Berridge Manufacturing Company, "Cee-Lock" or comparable product by one of the following:
 - a. AEP Span; a BlueScope Steel company.
 - b. CENTRIA Architectural Systems.
 - c. Fabral.
 - d. Firestone Building Products Company / Una-Clad.
 - e. MBCI; a division of NCI Building Systems, L.P.
 - f. Metal Sales Manufacturing Corporation.
 - g. Morin; a Kingspan Group company.
 - h. Petersen Aluminum Corporation.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.028 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Colors: Matching Existing Metal roofs – Berridge "Award Blue".
 - 1) Refer to Exterior Material Legend for colors.
 - 3. Clips: Manufacturer's standard one-piece fixed or two-piece floating to accommodate thermal movement and achieve wind uplift resistance specified.
 - a. Material: 0.050-inch-minimum nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
 - 4. Panel Coverage: 16 inches to 18 inches.
 - 5. Panel Height: 1.5 inches to 1.75 inches.
 - 6. Panel Seam: Seam shall also include factory-applied in-seam sealant.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment (074113.A03): Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 - 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

- B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- C. Gutters (074113.A07): Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- D. Downspouts (074113.A08): Formed from same material as roof panels. Fabricate in 10-foot- long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters, unless otherwise directed by Architect.
- E. Roof Curbs (074113.A09): Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
 - 1. Insulate roof curb with 1-inch- thick, rigid insulation.
- F. Panel Fasteners: Self-tapping screws designed to withstand design loads and as determined from pull-out tests.
- G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
 1. Apply over the entire roof surface.
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 - 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
 - 1. Install clips to supports with self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 - 4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - 2. Connect downspouts to underground drainage system indicated.
- J. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 074213 - METAL WALL AND SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concealed-fastener, lap-seam metal wall panels (074213.A03).
 - 2. Pre-manufactured rainscreen furring system (074213.A09).
- B. Related Sections:
 - 1. Section 054000 "Cold-Formed Metal Framing" for miscellaneous support framing.

1.2 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for metal panel assembly during and after installation.
 - 8. Review procedures for repair of metal panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, weep system, trim, flashings, closures, locations and types of sealants, accessories; and special details. Show locations of all cutouts.
 - 1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - 1) Indicate flashing and trim to be provided under work of this Section and to be provided by others.
 - 2) Indicate shape and method of attachment.
 - b. Anchorage systems. Show locations for any exposed fasteners.
 - c. Sealants: Indicate locations and types for factory-applied and field-installed sealants.
 - d. Where panels are indicated to receive custom perforated artwork, manufacturer shall provide elevations indicating location and extent of artwork proposed.
- C. Samples for Verification: For each type of exposed finish and panel type required, prepared on Samples of size indicated below.
 - 1. Metal Wall Panels: 6 to 12 inches long by actual panel width for each color. Include fasteners, closures, and other metal wall panel accessories.
 - a. Where panels are indicated to receive custom perforated artwork, provide a full size sample of area containing artwork. Architect shall select region of artwork to be provided on sample.
 - 2. Trim and Closures: 6 to 12 inches in length for each trim profile. Include fasteners and other exposed accessories.
 - 3. Accessories: 6 to 12-inch-long Samples for each type of accessory.

- D. Delegated-Design Submittal: For insulated metal wall panel systems, and concealed fastener metal wall panels.
 - 1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.
- B. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer, with not less than seven (7) years of successful experience under the current company name installing metal panels similar to those required for this Project.
- B. Manufacturer Qualifications: Manufacturer shall have a minimum of five (5) years of experience in production of metal panels similar in design to those specified.
- C. Source Limitations: Obtain each type of metal panel, associated trim and flashing from single source from single manufacturer.
- D. Integral Field Sample: Build in-place field samples each type of metal wall panel to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build field samples of typical wall panels as shown on Drawings, including insulation, supports, attachments, trim, and accessories.
 - 2. Water-Spray Test: Conduct water-spray test of field samples of metal panel assembly, testing for water penetration according to AAMA 501.2.
 - 3. Approval of field samples does not constitute approval of deviations from the Contract Documents contained in field samples unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved field samples may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels for period of metal panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of structural members and opening dimensions by field measurements before metal panel fabrication, and indicate measurements on Shop Drawings.

1.9 COORDINATION

- A. Coordinate metal panel installation with air barrier coating, subframing, roofing, coping, flashing, trim, construction of soffits, aluminum storefront, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 6.00 lbf./sq. ft..
- D. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure as indicated on Drawings.
 - 2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.
- E. Thermal Movements: For metal wall and soffit panels, allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 PANEL MATERIALS

- A. **Metallic-Coated Steel Sheet:** Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M. **Metallic-Coated Steel Sheet:** Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
- B. **Surface:** Smooth, flat finish.
- C. **Exposed Coil-Coated Finish:**
 - 1. **2-Coat Fluoropolymer:** AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. **Concealed Finish:** Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- D. **Panel Sealants:**
 - 1. **Sealant Tape:** Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. **Joint Sealant:** ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. **Butyl-Rubber-Based, Solvent-Release Sealant:** ASTM C 1311.

2.3 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS (074213.A03)

- A. **General:** Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. **Concealed-Fastener Metal Wall Panels (074213.A03 – Type 1, Type 2, Type 3):** Factory-formed, prefinished panels with flush profile, fastened to supports with concealed fasteners.
 - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide products listed below by Centria, or comparable products from other manufacturers, meeting specified requirements, submitted to and accepted by Architect prior to bidding.
 - a. Type 1: "Concept Series CS-660E" by Centria.
 - b. Type 2: "Concept Series CS-200" by Centria.
 - c. Type 3: "Concept Series CS-630E" by Centria.
 - 2. **Metallic-Coated Steel Sheet:** Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. **Nominal Thickness:** 20 gage.
 - b. **Exterior Finish:** Two-coat fluoropolymer or Three-coat fluoropolymer as necessary for color selected.
 - c. **Color:** As selected by Architect from manufacturer's full range.
 - 3. **Panel Coverage:** 12 inches (Type 2) and 16 inches (Type 1 and Type 3).
 - 4. **Panel Depth:** 7/8 inches.

2.4 PREMANUFACTURED RAINSCREEN FURRING SYSTEM (074213.A09)

- A. **Subframing/Furring System:**
 - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide "Horizontal CI Girt" as manufactured by Knight Wall Systems. Include all necessary inside and outside corner components and accessories for complete system to properly support metal wall panels.
 - a. Comparable products from other manufacturers will be considered when submitted to and accepted by Architect prior to bidding.
 - 2. **System Description and Performance Criteria:**
 - a. System shall be capable of supporting a cladding weight of up to 20 psf.
 - b. Component finish shall be corrosion-resistant 55 AL-ZN (AZ55) coating.

- c. System fasteners shall be manufacturer's standard, "ThermaStop Fasteners", incorporating thermal isolation of the stainless steel TEK fastener.

2.5 ACCESSORIES

- A. Panel Accessories: Provide components required for a complete metal panel assembly including trim, clips, flashings, sealants and similar items. Match material and finish of metal panels, unless otherwise indicated.
 - 1. Closures: Provide closures at perimeter, fabricated of same metal as metal wall panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. Flashing and Trim (074213.A07): Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
 - 1. Trim and closure flashing shall include, but not be limited to the following. Trim shall be finished to match adjacent wall panel, unless specifically indicated otherwise.
 - a. Inside corners and outside corners.
 - b. End-lap, end wall and soffit flashing.
 - c. Flashing at perimeters of openings and window panning adjacent to metal wall panels.
 - d. Expansion joints.
- C. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
- B. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Where exposed fasteners cannot be avoided, provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.
 - 1. Provide at all connections between aluminum and steel (including galvanized steel).
- C. Weep Strips: Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, 1/4 -inch thick by 2-inch high strips and continuous for entire width of panel installation; in grey color. Weep strips shall be custom cut to height specified.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Mortar Net USA, Ltd.
- D. Weep Tubes: Refer to Section 079200 for requirements.

2.6 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Metallic Fluoropolymer: AAMA 2605. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of work.
 - 1. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.
 - 2. Verify that prefinished metal flashing "by others" has been installed and weather-lapped to drain moisture to exterior.
 - 3. Verify that weather barrier/air and moisture barrier coating has been installed over sheathing or backing substrate behind metal wall panels to prevent air infiltration and water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before metal wall panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Framing: Install base angles, sills, zee furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

- B. Install subframing/furring in strict accordance with wall panel system manufacturer's written recommendations. Install system oriented vertically and spaced at 16 inches on center to align with wall framing.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.
- D. Weep Strip Installation: Prior to installing panel trim moldings, install weep strips between weather-resistive barrier and panel trim moldings at tops and bottoms of panels. Temporarily hold strips in place with manufacturer's recommended adhesive. Adhesive shall be applied in 3/4-inch diameter dots spaced at 12-inch centers. Bottom of weep strips shall align with top and bottom of wall panel system.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Commence metal panel installation and install minimum of 100 sq. ft. in presence of factory-authorized representative.
 2. Shim or otherwise plumb substrates receiving metal panels.
 3. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather/air barrier and flashings that will be concealed by metal panels are installed.
 4. Install screw fasteners in predrilled holes.
 5. Locate and space fastenings in uniform vertical and horizontal alignment.
 6. Install flashing and trim as metal panel work proceeds.
 7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
 9. Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 10. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.
- B. Fasteners:
 1. Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior. Exposed fasteners shall be colored to match adjacent panel.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.
 1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- E. Metal Wall Panels: Fasten metal panels to supports with fasteners at each interconnected joint at location and spacing recommended by manufacturer.
 1. Apply panels to avoid "panel creep" or application not true to line.
 2. Fasten panels to supporting substrate with concealed fasteners to best extent possible. Where exposed fasteners are unavoidable, provide colored metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. At mechanically seamed wall panels, install with clips and other mounting accessories as recommended by panel manufacturer. Install clips to supports with self-tapping fasteners.
 5. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 6. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 7. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.

8. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps; on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weathertight.
9. At panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

F. Rainscreen-Principle Installation for Wall Panels: Install using pre-manufactured furring system assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

1. Excludes wall panels on back sides of parapets.

G. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommended by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

3.4 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel assembly including trim, flashings, sealants, gaskets, fillers, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch *deep*, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed metal composite material wall panel installation, including accessories.

D. Metal wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed roof-drainage sheet metal fabrications.
 - 2. Formed low-slope roof sheet metal fabrications.
 - 3. Formed wall sheet metal fabrications.

- B. Related Sections:
 - 1. Section 061000 "Rough Carpentry " for wood nailers, curbs, and blocking.
 - 2. Section 074213 "Formed Metal Wall and Soffit Panels" for sheet metal flashing and trim integral with metal coping and prefinished sheet metal flashing.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site. Conduct meeting concurrently with roofing preinstallation conference.
 - 1. Contractor shall conduct a meeting at Project site Meet with Owner, Owner's Roofing Consultant, Architect, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, metal wall panels, aluminum storefront and curtain wall, and roof-mounted equipment.
 - 2. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 - 4. Review sequencing of sheet metal flashing installation with other related trades and air barrier coating installer to coordinate installation.
 - 5. Review requirements for insurance and certificates if applicable.
 - 6. Review sheet metal flashing observation and repair procedures after flashing installation.
 - 7. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, sections, attachment details, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Include identification of material, thickness, weight, and finish for each item and location in Project.
 - 2. Include details for forming, including profiles, shapes, seams, and dimensions.
 - 3. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 4. Include details of termination points and assemblies.
 - 5. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.

6. Include details of roof-penetration flashing.
7. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.
11. Shop drawings shall be reviewed and accepted by roofing membrane manufacturer's technical representative. A shop drawing cover letter shall be submitted by the roofing membrane manufacturer's technical representative stating all sheet metal details associated with roofing are acceptable. Shop Drawings for Section 076200 "Sheet Metal Flashing and Trim" should be reviewed concurrently with the Section 075216 "Modified Bituminous Membrane Roofing" section.

- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on 6 inch square samples of actual metal to be used in the work.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Sample Warranty: For special warranty.
- C. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 1. For copings and roof edge flashings that are ANSI/SPRI ES-1 compliant, shop shall be ANSI/SPRI ES-1 certified and listed as able to fabricate required details as tested and approved.
 2. Use adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and methods needed for proper performance of the work in this section.
 3. In acceptance or rejection of the work of this section, the Owner will make no allowance for lack of skill on the part of the workers.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual", Seventh Edition, unless more stringent requirements are specified or shown on Drawings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Fabricate and install copings and roof edge flashing to meet ANSI/SPRI ES-1 requirements and standards, but not less than capable of resisting the following forces: Fabricate and install roof edge flashing capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49:
 - 1. Wind Zone 1: For velocity pressures of 21 to 30 lbf/sq. ft.: 60-lbf/sq. ft. perimeter uplift force, 90-lbf/sq. ft. corner uplift force, and 30-lbf/sq. ft. outward force.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
 - 1. Contractor shall use gauges or thicknesses specified or as prescribed in the referenced standards for specific girths, whichever is greater.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: 2D (dull, cold rolled).
 - 2. Surface: Smooth, flat.
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2. Surface: Smooth, flat.
 - 3. Exposed Coil-Coated Finish:
 - a. Color 1 - Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - b. Color 2 - Metallic Fluoropolymer: AAMA 621. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color 3 - Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 4. Colors: As selected by Architect from manufacturer's full range. Refer to Exterior Finish Legend for color matching requirements for sheet metal flashing and trim.
 - 5. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet (076200.A01): Minimum 30 to 40 milsthick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer and compatible with self-adhering air barrier transition membrane.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
 - c. Henry Company; Blueskin PE200 HT.
- B. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.
- C. Flexible Membrane Closure (076200.A04): EPDM Sheet membrane; at roof expansion joints and building expansion joint bellows, provide non-reinforced flexible, black EPDM synthetic rubber sheet flashing of 45 to 60 mils thickness. EPDM sheet shall have a tensile strength of not less than 1200 psi, a tear resistance of at least 20 lbs per inch and an ultimate elongation of at least 250 percent. Provide with seam and splice tape, adhesives and all other accessories required for proper and watertight installation.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, termination bars, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
 - 3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Termination Bars: Provide stainless steel or aluminum bars; 1/8" thick with a 1" face and 8'-0" length. Bars shall be predrilled at 8" centers starting 4" in from each end. Selant as recommended by EPDM manufacturer.
 - 1. Provide at building expansion joint bellows and other locations as necessary for proper watertight installation.
- D. Solder:
 - 1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- E. Sealant Tape (076200.A02): Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- F. Elastomeric Sealant (076200.A03): Silyl-terminated polyether (hybrid) sealant.
 - 1. Basis-of-Design Product: Provide MasterSeal NP 150 by BASF Building Systems. Provide where required to seal joints in sheet metal flashing and trim and remain watertight.
- G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- H. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- I. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- J. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

- K. Pre-Manufactured Pourable Sealer Pockets: Use only on non-structural penetrations that are flexible and those that are closely spaced. Provide pre-fabricated pourable sealer pocket system filled with fast-setting, solvent-free, multi-use waterproof sealer. Pre-fabricated pourable sealer pocket components shall connect together by means of tongue-and-groove joints, and shall be manufactured from a high-strength, flexible polyurethane elastomer. Pocket components shall join together to create pockets of varying sizes.
1. Basis-of-Design Product: Subject to compliance with requirements, provide "Lockin Pocket interlocking Pitch Pocket System" as manufactured by Weather-Tite, or comparable product submitted to and accepted by Architect prior to bidding.
 2. Product Characteristics:
 - a. Pourable sealer pocket components and sealer color shall be black.
 - b. Height: Not less than 4 inches above field of roof.
 - c. Warranty: Not less than 2 years.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Cleats (076200.A36): Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and ANSI/SPRI ES-1 for application, Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than one gage thicker than thickness of metal being secured.
1. Cleats for coping and fascia caps shall be fabricated from not less than 0.040-inch-thick (20 gauge) galvanized steel and shall be continuous 10 foot lengths with ¼ inch gap between sections.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters (076200.A05): Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
1. Gutter Profile and sizes: As indicated on drawings according to cited sheet metal standard.
 2. Expansion Joints: Butt type with cover plate.
 3. Accessories: Wire-ball downspout strainer and valley baffles.

4. Gutters with Girth up to 20 Inches: Fabricate from the following materials:
 - a. Coil-Coated Galvanized Steel: 0.034 inch thick.

- B. Downspouts (076200.A07): Fabricate rectangular 3 x 5-inch downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
 1. Fabricate downspouts similar to SMACNA, Figures 1-24, 1-31, and 1-32B.
 2. Fabricated Hanger Style: SMACNA figure designation 1-35C.
 - a. Hangers shall be spaced evenly not greater than 10 feet on center between eave and finished grade.
 3. Fabricate from the following materials:
 - a. Coil-Coated Galvanized Steel: 0.034 inch thick.

- C. Parapet Scuppers (076200.A08): Fabricate scuppers of dimensions required with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
 1. Fabricate scupper similar to SMACNA, Figures 1-26A, 1-26B and 1-27A.
 2. Coil-Coated Galvanized Steel: 0.034 inch thick.

- D. Conductor Heads (076200.A09): Fabricate conductor heads to configurations and sizes indicated, similar to those shown in SMACNA, Figures 1-25F, 1-26A and 1-27A. Fabricate leading edge of scupper into conductor head similar to Figure 1-28, Section A-A with locked drip edge. Provide conductor heads with overflow indicator openings on both sides of conductor head box. Construct so bottom of overflow hole is 1-inch below scupper
 1. Fabricate from the following materials:
 - a. Coil-Coated Galvanized Steel: 0.034 inch thick.

- E. Splash Pans (076200.A10): Fabricate from the following materials:
 1. Galvanized Steel: 0.040 inch thick.
 2. Fabricate similar to SMACNA, Figure 1-36. Fabricate with 2 to 3 corrugations.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop 076200.A11) and Fascia (076200.A12): Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide cover plates. Shop fabricate interior and exterior corners.
 1. Joint Style: Butted with expansion space and 12-inch-wide, concealed backup plate.
 2. Fabricate edging similar to SMACNA, Figures 2-1B and 2-5C.
 3. Fabricate fascia similar to SMACNA, Figures 2-7A and 2-7B.
 4. Fabricate from the following materials: Coil-Coated Galvanized Steel: 0.034 inch thick.

- B. Copings and Caps (076200.A13): Fabricate in minimum 96-inch-long, but not exceeding 10-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.
 1. Coping Profile: Similar to SMACNA figures 3-1A, 3-4A and 3-8D, except where indicated otherwise.
 2. Cap Profile: Similar to SMACNA figures 3-8C and 4-5C, with 4-inch high flange.
 3. Joint Style:
 - a. At coping: Similar to SMACNA, Figure 3-1, Detail 2, with drive cleat over top and "J1" 3-inch lap joint on vertical faces.
 - b. At caps: Similar to SMACNA, Table 3-1, joint "J2" with butt + backup plate.
 4. Fabricate from the following materials:
 - a. Coil-Coated Galvanized Steel: 0.034 inch thick.

- C. Roof-to-Roof Expansion-Joint Cover (076200.A14): Fabricate from the following materials:
 1. Coil-Coated Galvanized Steel: 0.034 inch thick.
 2. Fabricate roof-to-roof expansion joint similar to SMACNA, Figure 5-5A.
 3. Where expansion joint occurs beneath metal wall panels, vertical legs of receiver shall be 4 inches tall and extend up behind rigid insulation.

- D. Roof to Wall Transition Expansion-Joint Cover (076200.A15): Fabricate from the following materials:
 1. Coil-Coated Galvanized Steel: 0.034 inch thick.
 2. Fabricate roof-to-wall expansion joint similar to SMACNA, Figures 5-1 and 5-6B.
 3. Where expansion joint occurs beneath metal wall panels, vertical legs of receiver shall be 4 inches tall and extend up behind weather resistive barrier/air barrier transition flashing.

- E. Counterflashing (076200.A18): Fabricate from the following materials:

1. Coil-Coated Galvanized Steel: 0.034 inch thick.
2. Fabricate similar to SMACNA, Figure 4-4D, spring action and two piece (with receiver).
3. Where indicated, fabricate counterflashing with integral reglet flange similar to SMACNA, Figure 4-4C.

F. Flashing Receivers (076200.A19): Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.
2. Where receivers are indicated to project through exterior wythe, horizontal leg of receiver shall be 3 to 3-1/2 inches long.
3. Where receivers are cut-in to masonry joint or partially embedded in masonry joint, fabricate similar to SMACNA, Figure 4-4C.
4. Where receivers are mechanically fastened to vertical surface, vertical leg of receiver shall be at least 4 inches tall, similar to SMACNA, Figure 4-5C with receiver formed similar to Figure 4-4D.

G. Roof-Penetration Flashing (076200.A20): Fabricate from the following materials:

1. Stainless Steel: 0.034 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Coil-Coated Galvanized Steel: 0.034 inch thick.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing (076200.A33): Fabricate from the following materials:

1. Galvanized Steel: 0.034 inch thick.

B. Pre-Finished Miscellaneous Metal Flashing and Trim (076200.A35): Fabricated from the following materials:

1. Coil-Coated Galvanized Steel: 0.034 inch thick.
2. Fabricate trim to configurations indicated.
3. At metal wall panels, fabricate to configurations indicated, with vertical leg not less than 4 inches tall to extend up and behind rigid insulation. Fabricate ends of flashing with end dams not less than 2 inches tall, and extending out to face of wall panel.
 - a. As occurs, provide leading edge with receiver to accept counterflashing.
4. At pan flashing for windows, storefront and curtain wall; fabricate to configurations indicated, with horizontal leg to extend 2 inches beneath window, storefront or curtain wall sill as occurs.
5. Fabricate pre-finished miscellaneous metal flashing in lengths of 8 to 10 feet. Overlap adjoining pieces 4 inches and seal joint watertight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.
- C. Flexible Membrane Closure EPDM Underlayment and Bellows: Install EPDM underlayment wrinkle free and continuously sealed between sheets and all laps for watertight installation at roof expansion joints to form a bellows. Install an additional sheet over the top of coping, wall caps, and expansion joint bellows securely attached to wall substrate and adhered to over top of blocking/curb and turned down 1-1/2 inches.
 - 1. Where indicated at expansion joints in vertical walls behind cavity insulation and foam-board air barrier, provide flexible membrane closure bellows. Secure to both substrates and seal edges and laps in accordance with membrane manufacturer's written recommendations.
- D. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. All new sheet metal work for associated with roofing, shall be closely coordinated with the installation of the new roofing system. Sheet metal associated with roofing shall be installed directly after roofing work such that roofing terminations shall not be left unprotected by metal.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 3. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 4. Provide individual cleats at all locations other than gravel stop (perimeter) edging, copings and cap flashing. Space individual cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 - 5. Provide continuous cleats for gravel top (perimeter) edging, copings and cap flashing. Interlock exterior bottom edge of copings and gravel stop (perimeter) edging and cap flashing with continuous cleat anchored to substrate at 2 inches in from each end and then at not greater than 12-inch centers. Bend tabs over fasteners.
 - 6. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 7. Torch cutting of sheet metal flashing and trim is not permitted.
 - 8. Install sealant tape where indicated.
 - 9. All lap joints in pre-finished miscellaneous metal flashing shall be sealed watertight.
 - 10. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel sheet.
 2. Do not use torches for soldering.
 3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- H. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inch in direction of water flow. Provide EPDM bellows and EPDM cap flashing beneath expansion joint cover as specified.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Fasten gutter spacers to front and back of gutter.
 2. Anchor and loosely lock back edge of gutter to continuous cleat.
 3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
 4. Anchor gutter with gutter brackets spaced not more than 36 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
 5. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
 2. Provide elbows at base of downspout to direct water away from building.
 3. Connect downspouts to underground drainage system.
- D. Splash Pans: Install where downspouts discharge on low-slope roofs. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.
- E. Parapet and Through-Wall Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
 2. Loosely lock front edge of scupper with adjacent flashing.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
 - 1. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 2 inches in from each end and then at not greater than 12-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 2 inches in from each end and then at not greater than 12-inch centers.
 - 2. Anchor interior leg of coping with screw fasteners and washers at 16 inch centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Pre-Finished Miscellaneous Metal Flashing: Coordinate installation of flashing with adjoining construction and air barrier coating. Seal lap joints watertight.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof hatches (077200.A03).
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for metal vertical alternating tread devices for access to roof hatches.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Include plans, sections, details, attachments to other work, and terminations to adjacent construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
 - 1. Size and location of roof accessories specified in this Section.
 - 2. Method of attaching roof accessories to roof or building structure and required clearances.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.6 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.7 WARRANTY

- A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

- A. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- B. Steel Pipe: ASTM A 53/A 53M, galvanized.
- C. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 - 1. Mill Finish: As manufactured.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 1. Fasteners for Aluminum and Stainless-Steel Sheet: Series 300 stainless steel.
- F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone.
- G. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 ROOF HATCH (077200.A03)

- A. Roof Hatches: Thermally broken, metal roof-hatch units with R-20 insulated lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company; "Type NB-50TB" for service stair (ship's ladder) access, or comparable product by one of the following:
 - a. Babcock-Davis.
 - b. Dur-Red Products.
 - c. Hi Pro International, Inc.
 - d. J. L. Industries, Inc.
 - e. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
 - f. Naturalite Skylight Systems; Vistawall Group (The).
 - g. Nystrom.
 - h. O'Keeffe's Inc.
 - i. Precision Ladders, LLC.

- B. Type and Size:
 - 1. Ship's Ladder (Service Stair) Access: Single-leaf lid, 30 inches wide by 54 inches long.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Aluminum sheet, 11 gauge, mill finished.
- E. Construction:
 - 1. Insulation: Polyisocyanurate board.
 - 2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid. Lid corners shall be fully welded. Lid shall be internally reinforced. Overlapping flange of lid shall not be less than 5 inches. Insulation thickness shall be 3 inches.
 - 3. Curb: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal curb. Curb corners shall be fully welded. Curb shall be 12 inches high. Insulation thickness shall be 3 inches. Curb shall have a 5-1/2 inch mounting flange.
 - 4. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
 - 1. Hinge pins shall be made of Type 316 stainless steel.
 - 2. Latch shall be an enclosed two-point spring latch.
 - 3. Lift Assistance: Provide compression spring operators enclosed in telescopic tubes. Furnish with automatic hold-open arm and grip handle release.
- G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company; "LadderUP Safety Post", Model LU-1 or comparable product from other roof hatch manufacturers meeting specified requirements.
 - 2. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 - 3. Height: 42 inches above finished roof deck.
 - 4. Material: Steel tube.
 - 5. Post: Not less than 1-5/8-inch- diameter pipe.
 - 6. Mounting: Unit shall be equipped with adjustable mounting hardware to accommodate various ladder rungs sizes and spacing.
 - 7. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: Yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.

3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof-Hatch Installation:
1. Install roof hatch so top surface of hatch curb is level.
 2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 3. Attach ladder-assist post according to manufacturer's written instructions.
- 3.3 REPAIR AND CLEANING
- A. Clean exposed surfaces according to manufacturer's written instructions.
 - B. Clean off excess sealants.
 - C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
- B. Related Sections:
 - 1. Division 07 Section "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
 - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
- C. Preinstallation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Grace Construction Products.
 - 2. Hilti, Inc.
 - 3. Johns Manville.
 - 4. Specified Technologies Inc.
 - 5. 3M Fire Protection Products.
 - 6. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - 7. USG Corporation.

2.2 PENETRATION FIRESTOPPING (078413.A01)

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Fire-resistance-rated walls include fire walls fire-barrier walls and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. VOC Content: Provide penetration firestopping that complies with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fillers for sealants.
 - 2. Substrate primers.
 - 3. Collars.

2.3 FILL MATERIALS

- A. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- B. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- C. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- D. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- E. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

- F. 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, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Firestopping Manufacturer's representative shall perform and inspections of penetration firestopping. Contractor shall notify Architect and manufacturer's representative no later than seven days after penetration firestopping is complete to schedule inspection.
 1. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
 2. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joints in or between fire-resistance-rated constructions. (078446.A01)
- B. Related Sections:
 - 1. Division 07 Section "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
 - 1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
 - 1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
 - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
 - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
- C. Pre-installation Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Coordinate fire-resistive joint systems with expansion joint systems to ensure integrity of fire-resistive barrier and accommodation of building movement.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS (078446.A01)

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
 - 1. Joints include those installed in or between fire-resistance-rated walls floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
 - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
 - 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Grace Construction Products.
 - b. Hilti, Inc.
 - c. Johns Manville.
 - d. Specified Technologies Inc.
 - e. 3M Fire Protection Products.
 - f. Tremco, Inc.; Tremco Fire Protection Systems Group.
 - g. USG Corporation.
- C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.
- E. Floor Joint Safing System: Joint system for use at edge of floor assembly and concrete spandrel or architectural precast.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Hilti Inc. "CW-D-1001" System or comparable product meeting specified requirements, by one of the manufacturers listed in Article 2.1.B.3, submitted to and accepted by Architect prior to bidding.
 - 2. Performance Requirements: Comply with performance requirements without failure due to defective manufacturing, fabrication, installation, or other construction defects.
 - a. Fire Resistance or Perimeter Fire Barriers: ASTM E2307.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.

2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 2. Apply fill materials so they contact and adhere to substrates formed by joints.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Fire-Resistive Joint System manufacturer's representative will perform inspections of completed installation of work of this Section. Contractor shall notify Architect and manufacturer's representative not later than seven days after completion of fire-resistive joint system installation to schedule inspection.
- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite

such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

- B. Wall-to-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: WW-S-0000-0999.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class II - 25 percent compression or extension.
 - 5. L-Rating at Ambient: As selected by Contractor to suit project conditions.

- C. Floor-to-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: FW-S-0000-0999.
 - 1. Assembly Rating: 2 hours.
 - 2. Nominal Joint Width: As indicated.
 - 3. Movement Capabilities: Class II - 25 percent compression, extension, or horizontal shear.
 - 4. L-Rating at Ambient: As selected by Contractor to suit project conditions.

- D. Head-of-Wall, Fire-Resistive Joint Systems:
 - 1. UL-Classified Systems: HW-S-0000-0999.
 - 2. Assembly Rating: 2 hours.
 - 3. Nominal Joint Width: As indicated.
 - 4. Movement Capabilities: Class II - 25 percent compression or extension.
 - 5. L-Rating at Ambient: As selected by Contractor to suit project conditions.

- E. Perimeter Fire-Resistive Joint Systems:
 - 1. UL-Classified Perimeter Fire-Containment Systems: CW-S-0000-0999.
 - 2. Integrity Rating: 2 hours.
 - 3. Insulation Rating: 1 hour.
 - 5. Linear Opening Width: As indicated.
 - 4. Movement Capabilities: Class II - 25 percent compression or extension.
 - 5. L-Rating at Ambient Temperature: As selected by Contractor to suit project conditions.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Polyurea joint sealants.
 - 4. Latex joint sealants.

- B. Related Sections:
 - 1. Section 078446 "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
 - 2. Section 088000 "Glazing" for glazing sealants.
 - 3. Section 092900 "Gypsum Board" for acoustical sealant and sealing acoustical joints.
 - 4. Division 32 Section "Concrete Paving Joint Sealants" for sealing joints in pavements, walkways, and curbing.

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate in exterior walls.
 - b. Sealant around perimeter of exterior windows/storefront.
 - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
 - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
 - 1. Submittals must be cross referenced to related Articles and paragraphs in this section for each product.

- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

- D. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

C. Field-Adhesion Test Reports: For each sealant application tested.

D. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1. Refer to Sections 034100 "Precast Structural Concrete" and 042000 "Unit Masonry" for sealant joint in mockups.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 COORDINATION

A. Coordinate building expansion joint systems with fire-resistive joint systems to ensure integrity of fire-resistive barrier and accommodation of building movement.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.
- F. Keynote Designations: Refer to schedule at end of this Section for types and applicable substrates.
 - 1. Sealant: (079200.A01).
 - 2. Sealant with backer rod: (079200.A02).
 - 3. Acoustical sealant: (079200.A04): Refer to Section 092900.
 - 4. Tape Sealant (079200.A05).

2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Non-Staining, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.
- B. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use T.
- C. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

2.3 URETHANE JOINT SEALANTS

- A. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.
- B. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.4 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation; AC-20+.
 - b. Tremco Incorporated; Tremflex 834.
 - c. Alternative acceptable manufacturer's with comparable products are GE, Sonneborn and Dow.

2.5 POLYUREA SEALANTS

- A. Polyurea Sealant: Semi-rigid, self-leveling, 2-part type. Shore D hardness of 85 when tested in accordance with ASTM D 2240. Tensile strength of 1160 pounds per square inch when tested in accordance with ASTM D 412.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Curecrete Distribution Company, Inc.; Ashford Crete-Fill.
 - b. L&M Construction Chemicals, Inc.; Joint Tite 750.
 - c. Adhesives Technologies Corp.; Crackbond JF311.

2.6 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings (079200.A04): ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape (079200.A05): Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
- D. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD in length to accommodate metal panel depth.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Exterior insulation and finish systems.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning

materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE (079200.A01)

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between stoop slabs and vertical construction such as buildings.
 - c. Joints between different materials listed above.
 - 2. Urethane Joint Sealant: Multicomponent, pourable/nonsag, traffic grade, Class 25.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast concrete units.
 - c. Joints in formed metal wall panels.
 - d. Joints within storefront assemblies.
 - e. Control and expansion joints.
 - f. Joints between different materials listed above.
 - g. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - h. Control and expansion joints in ceilings and other overhead surfaces.
 - 2. Silicone Joint Sealant: Single component, non-staining, nonsag, neutral curing, Class 50.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated, except for expansion and control joints.
 - 2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 25.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Expansion joints in tile and resinous flooring.
 - 2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing, Class 100/50.
 - 3. Joint Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior control/contraction joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Control/contraction joints in concrete slabs indicated to receive sealed finish, resinous flooring and joints in slabs on grade extending to building exterior, seal watertight.
 - 2. Polyurea Joint Sealant: Polyurea, multi component, self-leveling, traffic grade.
 - 3. Joint Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Vertical joints on exposed surfaces of interior unit masonry and concrete.
 - 2. Joint Sealant: Urethane, multicomponent, nonsag, Class 25.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint Sealant Application: Interior joints in vertical surfaces.
 - 1. Joint Locations:
 - a. Vertical joints in exposed surfaces of gypsum drywall partitions.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

2. Joint Sealant: Acrylic based, paintable.
 3. Joint Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing, Silicone.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.
 - 1. Interior hollow-metal doors (081113.A01).
 - 2. Interior hollow-metal frames (081113.A03).
 - 3. Exterior insulated hollow-metal doors (081113.A02).
 - 4. Exterior hollow-metal frames (081113.A03).

- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
 - 2. Section 088000 "Glazing" for vision lite glass in doors.
 - 3. Section 099113 "Exterior Painting" for field painting of exterior hollow-metal work.
 - 4. Section 099123 "Interior Painting" for field painting of hollow-metal work.
 - 5. Section 133419 "Metal Building Systems" for windows.
 - 6. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.

- B. Shop Drawings: Include the following:
 - 1. Furnish a schedule of doors and frames using same reference numbers for details and openings as those on Drawings.
 - 2. Elevations of each door type.
 - 3. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 4. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 5. Locations of reinforcement and preparations for hardware.
 - 6. Details of each different wall opening condition.
 - 7. Details of anchorages, joints, field splices, and connections.
 - 8. Details of accessories, moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.

- C. Samples for Verification:
 - 1. For each type of exposed finish required, prepared on Samples of not less than 6 by 8 inches.

- D. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
 - 2. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- B. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceco Door Products; an Assa Abloy Group company.
 - 2. Curries Company; an Assa Abloy Group company.
 - 3. Republic Doors and Frames.
 - 4. Steelcraft; an Allegion company.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors (081113.A01):
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (18 gauge).
 - d. Edge Construction:
 - 1) Model 1, Full Flush
 - e. Core: Kraft-paper honeycomb.
 - 3. Frames (081113.A03): Provide at all Level 3 hollow-metal doors and wood doors.
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (16 gauge).
 - b. Construction: Face welded.
 - c. Reinforcement: Provide high frequency hinge reinforcement at top hinge location.
 - 4. Exposed Finish: Prime.

2.3 EXTERIOR DOORS AND FRAMES

- A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 4.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors (081113.A02):
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Metallic coated, cold-rolled steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
 - d. Edge Construction: Model 2, seamless.
 - e. Top of Door: Provide top of door with flush top cap.
 - f. Core: Steel stiffeners with fiberglass or mineral wool batt insulation.

3. Frames (081113.A03): Provide at all Level 3 and Level 4 hollow-metal doors and wood doors.
 - a. Materials: Metallic coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
 - 1) Provide uncoated steel sheet for interior frames, same thickness as exterior frames.
 - b. Construction: Face welded.
 - c. Reinforcement: Provide high frequency hinge reinforcement at top hinge location.
4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 1. General: Anchors for severe storm-resistant door and frame assemblies shall be of sufficient length to provide not less than 5 inches of embedment into adjacent wall construction at jamb.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Section 088000 "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.

2. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
 3. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
 4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
- C. Provide high frequency hinge reinforcement on top hinge only (two additional 10 gauge reinforcements are welded at 3 places each) on all door frames.
- D. Reinforce doors and frames to receive continuous hinges where scheduled.

3.3 INSTALLATION

- A. Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting. Provide mortar guards for hinge and strike plate cutouts and any electrical components attached to frames.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 - 5. In-Place Concrete: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with plastic-laminate veneer faces (081416.A01)
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
 - 4. Custom Wood doors.
- B. Related Requirements:
 - 1. Section 064023 "Interior Architectural Woodwork" for door cladding and alignment with adjacent wall.
 - 2. Section 081113 "Hollow Metal Doors and Frames" for hollow metal frames.
 - 3. Section 087100 "Door Hardware" for hardware in flush wood doors.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
 - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide Samples for each type of plastic laminate facing required.
 - 3. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Certificates: For door manufacturer as set forth in Quality Assurance article.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.
- B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually to prevent damage to the doors and the factory finish.
- C. Mark each door on top rail with opening number used on Shop Drawings.
- D. Coordinate and deliver factory-primed flush wood doors to Architectural Woodwork Contractor for application of markerboard laminate, deliver these doors in timely manner to avoid delaying project.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period or as recommended by the manufacturer in writing to ensure compliance with wood door warranty.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma / Marshfield / Mohawk / Masonite Architectural Doors.
 - 2. Eggers Industries.
 - 3. Graham Wood Doors; an Assa Abloy Group company.
 - 4. Oshkosh Door Company.
 - 5. VT Industries, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
 - 1. Provide labels indicating that doors comply with requirements of grades specified.
- B. WDMA I.S.1-A Performance Grade:
 - 1. Extra Heavy Duty unless otherwise indicated
- ~~C. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
 - 2. Provide doors with structural-composite-lumber-cores instead of particleboard-cores for doors indicated to receive exit devices.~~
- D. Structural-Composite-Lumber-Core Doors:
 - 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.

2.3 DOORS FOR OPAQUE FINISH

- A. Exterior Solid-Core Doors - D1, E1:
1. Grade: Custom.
 2. Faces: MDO, Any closed-grain hardwood of mill option.
 - a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
 - b. D1 – Refer to 064023 for reclaimed lumber. **Lumber to be mechanically fastened as well as adhesive. Can these be seen?**
 - c. E1 – Refer to 055000 for metal face sheet requirements.
 3. Exposed Vertical and Top Edges: Any closed-grain hardwood.
 4. Core: Either glued wood stave or structural composite lumber.
 5. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
 6. Adhesives: Type I per WDMA T.M.-6.
 7. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors (081416.A01) C1:
1. Grade: Premium, with Grade A faces.
 2. Species: Red oak.
 3. Cut: Plain sliced (flat sliced).
 4. Match between Veneer Leaves: Book match.
 5. Assembly of Veneer Leaves on Door Faces: Running match.
 6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
 7. Exposed Vertical and Top Edges: Same species as faces - edge Type A.
 8. Core: Particleboard or structural composite lumber.
 9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
 10. **[Doors thickness for the sliding barn doors shall be 1-3/8 inches.]** AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" requires Grade AA faces for Premium-grade doors; WDMA I.S.1-A requires Grade A faces for Premium-grade doors. Both standards require Grade A faces for Custom-grade doors unless Grade B is specified. See Evaluations.
 11. Grade: [Premium, with Grade AA faces] [Premium, with Grade A faces] [Custom (Grade A faces)].
 12. Species: [Anigre] [Select white ash] [Figured select white ash] [Select white birch] [Select red birch] [Cherry] [Select red gum] [Figured select red gum] [Select white maple] [Red oak] [White oak] [Persimmon] [Sapele] [Sycamore] [Walnut] <Insert species>.
 13. Cut: [Rotary cut] [Plain sliced (flat sliced)] [Quarter sliced] [Rift cut].
 14. Match between Veneer Leaves: [Book] [Slip] [Pleasing] match.
 15. Assembly of Veneer Leaves on Door Faces: [Center-balance] [Balance] [Running] match.
 16. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet.
 17. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 18. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."
 19. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
 20. Core: Either glued wood stave or structural composite lumber.
 21. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
 22. Construction: Seven plies, either bonded or nonbonded construction.
 23. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.5 LIGHT FRAMES

- A. General: Light frames are to match light frames in existing doors for each school. Contractor shall field verify material type and profile for light frames.
- B. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
1. Wood Species: Same species as door faces.

2. Profile: Manufacturer's standard shape to match existing.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

C. Metal Frames for Light Openings in Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish.

1. Color: As selected by Architect from manufacturer's full range of custom options.

2.6 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.7 SHOP PRIMING

<< COORDINATE PRIMING BELOW WITH SLIDING BARN DOORS >>

A. Doors for Opaque Finish: Shop prime one face, [all four edges], edges of cutouts, and mortises with one coat of wood primer specified in Section 099123 "Interior Painting."

B. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in [Section 099113 "Exterior Painting."] [Section 099123 "Interior Painting."]

C. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing." Seal edges of cutouts and mortises with first coat of finish.

2.8 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings (083113.A01).
- B. Related Requirements:
 - 1. Section 042000 "Masonry" for coordinating doors and frames set in masonry.
 - 2. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- 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. Babcock-Davis.
 - 2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
 - 3. Karp Associates, Inc.
 - 4. Larsen's Manufacturing Company.
 - 5. Milcor Inc.
 - 6. Nystrom, Inc.
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Recessed Access Doors with Concealed Flanges (083113.A01):
 - 1. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
 - 2. Locations: Wall and ceiling.
 - 3. Door Sizes:
 - a. 24" x 24" unless otherwise specified.
 - b. 12" x 12" where indicated for access to water shut-off valves.
 - 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
 - 5. Metallic-Coated Steel Sheet for Door: Provide in restrooms and other wet areas. Nominal 0.064 inch, 16 gage, factory primed.
 - 6. Hinges: Manufacturer's standard.

7. Hardware: Provide hardware as follows:
 - a. At non-public spaces provide latching hardware.
 - b. At public spaces accessible to students, provide locking hardware.

- D. Hardware:
 1. Latch: Cam latch operated by screwdriver.
 2. Lock: Cylinder.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- D. Frame Anchors: Same type as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior and interior storefront framing.
2. Storefront framing for window walls.
3. Storefront framing for punched openings.
4. Interior heavy-duty manual-swing aluminum doors.
5. Installation of finish hardware for heavy-duty doors.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for installation of joint sealants installed in storefronts and entrance framing and for sealants not specified in this Section.
2. Section 084413 "Glazed Aluminum Curtain Walls" for curtain walls to receive doors and subframes.
3. Section 087100 "Door Hardware" for door hardware for aluminum doors.
4. Section 088000 "Glazing" for glass within storefront and entrance systems.

1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, installation instructions, material descriptions, dimensions of individual components and profiles, hardware, accessories and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Elevations shall be drawn at 1/2 inch scale.
2. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Interface with adjoining building construction.
 - d. Expansion provisions.
 - e. Glazing.
 - f. Flashing and drainage.
4. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Shop Drawings shall be signed and sealed by a structural engineer licensed in the state where the project is located.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1. Architect reserves the right to require additional samples for verification purposes that show fabrication techniques and workmanship.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

- F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- G. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of aluminum-framed systems.
 - 2. Include design calculations.
 - 3. Indicate design solutions for deflections of overhead structure as indicated on Structural Drawings.
 - 4. For aluminum-framed entrances and storefronts indicated to receive laminated (security) glazing systems, indicate design solutions recommended by laminated (security) glazing manufacturer to provide forced entry resistance level indicated in Section 088000 "Glazing".

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and field-testing agency.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
 - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Preconstruction Test Reports: For sealant.
- E. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances, storefronts and sunshade to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- D. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- E. Source Limitations:

1. For Aluminum-Framed Storefront Systems: Obtain from single source from single manufacturer.
2. For Heavy-Duty Door Systems: Obtain from single source from single manufacturer.

F. Listings and Labels for Fire-Rated Framing: Fire rated framing and glazing shall be under current follow-up services by an approved independent agency and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

1.7 MOCKUPS

- A. Mockups/Field Samples: Build mockups/field samples, to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Mockups/Field Samples: Furnish and install quantity and size of aluminum windows indicated on Drawings within mockup constructed under Section 042000 "Unit Masonry." Mockup/Field Sample will be used set quality standards for materials and execution.
 - a. Install aluminum window to demonstrate surface preparation and installation of: jamb closure membrane, subsill, window framing, and application of perimeter window sealant and associated flashing.
 - b. Window shall include specified glazing where mockup is erected.
 - c. Maintain a 3/8 to 1/2 inch wide gap around entire perimeter of window to receive sealant.
 - d. Coordinate installation of window within mockups to permit inspection by Architect. Approved window installation will set quality standard of installation and aesthetic qualities of workmanship for project.
 2. Field Samples: Build field sample/mockup of typical wall areas as shown on Drawings.
 - a. Note: Mockup shall be a field sample of storefront, entrance and punched opening areas in Project. Architect and manufacturer's representative will observe installation of first 100 square feet of storefront installation and 100 square feet of entrance framing installation.
 3. Field testing shall be performed on field sample areas according to requirements in "Field Quality Control" Article.
 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 5. Subject to compliance with requirements, approved mockups/field sample areas may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver aluminum framing components in manufacturer's original protective packaging.
- B. Store aluminum components in a clean dry location away from uncured masonry and concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.
1. Stack framing components in a manner that will prevent bending and avoid damage.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Check openings by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work.
- B. Commencement of aluminum entrance and storefront work will be construed as Installer's acceptance of substrate surfaces and rough openings indicated to receive work of this Section.

1.10 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: Two years from date of Substantial Completion.
 3. Warranty period for heavy-duty doors and associated frames shall be ten (10) years from date of Substantial Completion.

- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 - 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
 - b. Refer to Structural Drawings for additional information regard structure and deflection criteria.
 - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.
- E. Structural: Test according to ASTM E 330 as follows:
 - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
 - 1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.04 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
 - 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.

- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10.0 lbf/sq. ft. for entrance/storefront framing.
 - 2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- H. Swing Door Cycle Test: Test doors and frames according to ANSI A250.4 as follows:
 - 1. Minimum 16,000,000 cycles.
- I. Cycle Slam Test Method: Test according to NWWDA T.M. 7-90 as follows:
 - 1. Minimum 1,000,000 cycles.
- J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
 - 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
- K. Surface Burning Characteristics for FRP Face Sheets:
 - 1. Exterior Panels: All FRP face sheets located on the exterior shall meet ASTM E 84, Class "C" requirements.

2.2 MANUFACTURERS AND PRODUCTS

- A. Basis-of-Design Criteria: Drawings indicate sizes, profiles, and dimensional requirements for storefront, entrance and window framing systems required, that are based on specific types, models and performance criteria indicated. Systems from other manufacturers may be considered, provided deviations in dimensions, profiles and performance are minor and do not change the design concept as judged by the Architect. Burden of proof is on the proposer.
- B. Basis-of-Design Products for Storefront Framing System: Subject to compliance with requirements, provide or one of the systems listed below or comparable product submitted to and accepted by Architect prior to bidding.
 - 1. Thermally Broken Storefront and Entrance Framing (084113.A01 – Center Plane Glazed):
 - a. Basis of Design: Kawneer North America; Trifab VG 451T.
 - b. EFCO Corporation; S 403.
 - c. Manko Windows and Doors; 2450 Series.
 - d. Tubelite; 14000.
 - 2. Interior standard-duty manual-swing doors (084113.A06):
 - a. Basis-of-Design: Kawneer North America; Series 500 Wide Stile.
 - b. EFCO Corporation; D-500.
 - c. Manko Windows and Doors; 150 Series.
 - d. Tubelite; Comparable product.
- C. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Construction: Thermally broken and Nonthermal.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: Front plane glazed for interior locations and front-and center plane-glazed at exterior locations.
 - a. Coordinate orientation of interior front plane glazed systems with Architect by clearly indicating the location of the front plane on shop submittals prior to fabrication.
 - 4. Finish: High-performance organic finish; Refer to drawings.
 - 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
 - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Aluminum Stile-and-Rail Doors (084113.A06): 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets/plates that are deeply penetrated and fillet welded and/or incorporate concealed tie rods.
 - a. Interior standard-duty manual-swing doors (084113.A06): Doors shall have 5-inch wide stiles, 5-inch top rail, 6.5 inch intermediate rail and 10 inch bottom rail.
 - 2. Thermal Construction: Manufacturer's standard elastomeric type.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
- B. Entrance Door Framing and Subframing:
 - 1. Basis-of-Design Products:
 - a. Door Framing: Special-Lite, Inc.; "SL-245FG", compatible with storefront framing system (No substitutions allowed).
 - b. Door Subframing: Manufacturer's standard, not greater than 1-inch face dimension for use at entrances within curtain wall. Finish to match adjacent curtain wall framing.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
 - 1. Hardware for heavy-duty aluminum doors shall be installed at the door manufacturer's factory and be included in the warranty.
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule, and as specified hereinafter.
- C. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- D. Weather Stripping: Manufacturer's standard replaceable components. "Fin" type stops and vinyl weatherstripping are not acceptable.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- E. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
 - 1. Sealant shall have a VOC content of 250 g/L or less.
- D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with other system components with which it comes in contact; recommended by weatherseal-sealant and glazed storefront manufacturers for this use.
- E. Security Glazing: Provide a minimum edge engagement of 5/8" to augment performance.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of exposed hardware, use exposed fasteners with countersunk Phillips screw heads or flat-head machine screws, fabricated from 300 series stainless steel.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Aluminum Subsills (084113.A07): Provide high performance subsill that incorporates a watertight interior back leg with end dams and integral water collection trough that weeps to exterior. Subsill shall be of profile and dimensions required for installation indicated. Finish subsill to match adjacent aluminum framing. Seal all penetrations through subsills to be watertight.
 - 1. Provide high performance subsills at all storefront, entrance and window framing, unless specifically indicated otherwise.
- D. Aluminum Closure Flashing (084113. A08): Provide prefinished aluminum, not less than 0.090 inch thick, of alloy and type selected by manufacturer for compatibility with other components. Fabricate closure flashing to configurations indicated. Finish to match adjacent storefront, entrance and window framing. Seal closure flashing to be watertight.
- E. Aluminum Pan Flashing (084113.A09): Provide prefinished aluminum, not less than 0.090 inch thick, of alloy and type selected by manufacturer for compatibility with other components. Fabricate pan flashing to configurations indicated to direct water to exterior away from storefront and window framing. Finish to match adjacent storefront and window framing.
- F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- G. Aluminum Snap Trim: Provide prefinished aluminum trim, in manufacturer's standard thickness, of alloy and type selected by manufacturer for compatibility with other components. Snap trim shall be two-piece trim, including continuous trim clip and continuous trim cover. Finish for trim clip shall be mill finish. Finish for trim cover to match adjacent storefront and window framing.
 - 1. Size: 1 by 1-1/4 inches.

- H. Jamb Closure Membrane (084113.A11):
 - 1. Fire Propagation Characteristics: When flexible strip flashing is used in exterior walls, the flashing shall pass NFPA 285 testing as part of an approved assembly. Flashing shall be compatible with air barrier coating specified in Section 072729.
 - 2. Product Characteristics:
 - a. Self-adhering, membrane, 40 mils thick.
 - b. Flashing shall function as an air, vapor and water barrier.
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Coatings and Waterproofing; "CCW-705-TWF";
 - a. Comparable products from the following, meeting specified requirements, will be considered when submitted to and accepted by Architect prior to bidding:
 - 1) "Perm-A-Barrier Wall Flashing"; as manufactured by Grace Construction Products.
 - 2) "Air-Shield"; as manufactured by W. R. Meadows, Inc.
 - 3) "Blueskin"; as manufactured by Henry Corp.
- I. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.
- J. Head Compensating Receptor (084113.A15): Provide manufacturer's high performance head compensating receptor as required. Provide prefinished aluminum, of alloy and type selected by manufacturer for compatibility with other components. Finish to match adjacent storefront, entrance and window framing. Seal all penetrations through head to be watertight.
 - 1. Provide high performance head compensating receptor as indicated on the drawings.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from interior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Storefront Framing: Fabricate components for assembly using shear-block system, ~~or~~ screw-spline system, or head-and-sill-receptor system with shear blocks at intermediate horizontal members.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
 - 2. Fin-type door stops are not acceptable.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. Aluminum standard doors shall be fabricated as previously specified.
 - 2. Reinforce doors as required for installing entrance door hardware.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF or FEVE resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: Black as indicated on the Material Finish Legend.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that are in contact with sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
 - 7. Completely fill gaps between shims and adjacent construction with loose fiberglass insulation.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
 - 1. Install two-piece snap trim with long leg oriented horizontally and short leg fastened to aluminum framing, so that trim cover is exposed, and trim clip is concealed. Secure trim to aluminum framing and adjacent construction in accordance with trim manufacturer's written instructions.
- E. Prior to installation of perimeter vertical members, install jamb closure membrane at cavity walls to cover gap/joint between interior and exterior substrates. Intent is to seal air cavity and joints between substrates. Extend membrane from interior face of framing/blocking to exterior. Trim membrane so that it will not be exposed to view after vertical members are set, and edge of membrane is terminated in sealant installed around perimeter of aluminum framing.
 - 1. Seal tops of end dams at jambs to adjacent construction or extend jamb closure membrane over end dam to direct water into subsill in order to drain to exterior.
- F. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- G. Install glazing as specified in Section 088000 "Glazing."

- H. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- I. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
 - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
 - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform tests in each test area as directed by Architect.
 - 1) For punched openings, test 25 percent of installation, in each type of exterior finish substrate, unless noted otherwise.
 - 2) For storefront, and clerestories; test each installation, unless noted otherwise.
 - 2.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Intent: The intent of this Section is to provide finish hardware for the proper operation and control of all wood, hollow metal and aluminum doors in the Project. Prior to bidding, notify the Architect of any doors that do not have hardware meeting this intention.
- B. This Section includes items known commercially as finish or door hardware that are required for swinging doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed. This Section includes, but is not necessarily limited to furnishing and installing complete, the following:
 - 1. Finish hardware for proper operation and control of all wood, aluminum and hollow metal doors, including hinges, locks and latch sets, closers, panic devices, auto-flushbolts, electric strikes, magnetic holders, removable mullions, cylinders, keys, miscellaneous stops, flat goods, weatherstripping and thresholds as required.
 - 2. Cylinder for access doors where specified.
- C. Related work in other sections:
 - 1. Hollow metal doors, frames and silencers: Section 081113.
 - 2. Wood doors: Section 081416.
 - 3. Aluminum doors: Section 084113.

1.2 DEFINITIONS

- A. "Finish Hardware" includes items known commercially as finish hardware which are required for swing, and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturers technical product data for each hardware item. Include information necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finishes.
 - 1. Manufacturer shall submit written certification confirming closers compliance with U.L. 10C.
- B. Hardware Schedule: Submit a hardware schedule in a vertical format (horizontal format not acceptable), organized into sets, including the information below. Designations for door numbers and hardware sets in the schedule shall match those used in the Construction Documents for each opening.
 - 1. Hardware Schedule shall be coordinated with doors, frames, and related work to ensure proper size, thickness, hand function, and finish of door hardware.
 - 2. Catalog cuts of each type of exposed hardware unit, highlighted in color to indicate compliance with the Hardware Schedule.
 - 3. Type, style, function, size and finish of each hardware item.
 - 4. Name and manufacturer of each item.
 - 5. Fastenings and other pertinent information.
 - 6. Explanation of all abbreviations, symbols, codes, etc., contained in schedule.
 - 7. Mounting locations for hardware.
 - 8. Door and frame sizes and materials.
 - 9. Deviations from Specifications shall be noted in cover letter.
- C. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.

- D. Keying Schedule: Submit separate detailed schedule, at the same time as the Hardware Schedule, indicating keying for all locks and how Owner's instructions, on keying of locks has been fulfilled. Keying schedule must be approved before ordering any locks.
- E. Pinning Transcript: Submit detailed schedule indicating each lock cylinder and core.
- F. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- B. Product/Material Qualifications: Manufacturer's product numbers are indicated for convenience in identifying finish hardware items. Unless otherwise indicated, manufacturer's description for indicated product number constitutes minimum standards of quality, design, function and performance required for each item to be incorporated into the Project.
 - 1. It will be the responsibility of the Bidder to furnish with his Bid a list clarifying any deviations from these specifications written or implied, in order that a fair and proper evaluation be made. Those Bidders not submitting a list of deviations will be presumed to have Bid as specified.
- C. Supplier Qualifications: A recognized Architectural Finish Hardware Supplier, with warehousing facilities, who has been furnishing hardware in the project's vicinity for a period of not less than 2 years. Supplier shall be or employ an experienced Architectural Hardware Consultant (AHC) who is certified by and member of the Door and Hardware Institute. The Architectural Hardware Consultant shall be available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to Owner, Architect and Contractor.
 - 1. Supplier shall meet with the Owner to finalize keying requirements and obtain final instructions in writing.
- D. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Pamphlets No. 80, No. 101 and of authorities having jurisdiction requirements. Provide only hardware which has been tested and listed by UL, FM or Warnock Hersey for types and sizes of doors required and complies with requirements of door and door frame labels.
 - 1. Where emergency exit devices are required on fire-rated doors, (with supplementary marking on doors' UL or FM labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide UL or FM label on exit devices indicating "Fire Exit Hardware".
- E. Standards: Comply with the requirements of the latest edition of the following standards, unless indicated otherwise:
 - 1. American National Standards Institute (ANSI) Publications:
 - a. A115 Series - Door and Frame Preparation.
 - b. A156 Series - Hardware.
 - 2. Builders Hardware Manufacturers Association (BHMA) Publications:
 - a. 1201 - Auxiliary Hardware.
 - b. 1301 - Materials and Finishes.
 - 3. Door and Hardware Institute (DHI) Publications:
 - a. Keying - Procedures, Systems, and Nomenclature.
 - b. Abbreviations and Symbols.
 - c. Hardware for Labeled Fire Doors.
 - d. Recommended Locations for Builder's Hardware for Standard and Custom Steel Doors and Frames.
 - e. Wood Door Standards W1, W2, WDHS-2, WDHS-3.
 - 4. National Fire Protection Association (NFPA) Publications:
 - a. NFPA Pamphlet No. 80 - Standards for Fire Doors and Windows.
 - 5. International Building Code - current edition adopted.
 - 6. Americans with Disabilities Act (ADA).
- F. Keying Conference: Conduct conference in accordance with Section 013100. In addition to Owner, Construction Manager, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.

3. Requirements for key control system.
4. Address for delivery of keys.

- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Section 013100 as follows:
1. Architectural Finish Hardware supplier (AFHS) shall conduct the preinstallation conference at the site. The AFHS shall instruct finish hardware installer on proper installation, adjustment and troubleshooting for each operable item of finish hardware specified. The AFHS shall observe the installation and adjustment of the first three locksets, closers and exit devices.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Package each hardware item in separate containers with all screws, wrenches, installation instructions and installation templates. Mark or tag each box with hardware heading and door number according to approved hardware schedule.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation. Provide a complete packing list showing items, door numbers and hardware headings with each shipment.
- D. Store hardware in shipping cartons above ground and under cover to prevent damage.
1. Provide secure lockup for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.
- E. Aluminum Door Hardware: If required by door manufacturer deliver hardware for aluminum doors as directed by the door supplier for factory installation.

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system, as applicable.
- C. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
1. Fire ratings of existing doors and frames are to be maintained, provide hardware accordingly.

1.7 MAINTENANCE

- 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 HARDWARE - GENERAL

- A. Provide the materials or products indicated by trade names, manufacturer's name, or catalog number.
- B. Provide manufacturer's standard products meeting the design intent of this Specifications, free of imperfections affecting appearance or serviceability.

1. Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.
 2. Provide hardware complete with all fasteners, anchors, instructions, layout templates, and any specialized tools as required for satisfactory installation and adjustment.
 3. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
 4. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated or approved. Finish screws exposed under any condition to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as
 5. Finish all other hardware in accordance with the BHMA finish as follows, unless otherwise indicated in manufacturers screws to secure hardware.
 6. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work, except where indicated otherwise or where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex bolt fasteners.
 7. Provide factory pinned cylinders and cores.
- C. Hardware is specified in the hardware schedule by set, type, and functions which have been selected as best meeting the application requirements. Acceptable products for each category are specified under PART 2 of this Specification.

2.2 SPECIAL REQUIREMENTS

- A. Hinges:
1. Provide non-removable pins for all exterior doors and out-swinging corridor doors. Use nonrising pins for all other doors.
 2. Pre-drill pilot holes for hinge fasteners at factory to suit hinge type.
 3. Provide continuous hinges where specified.
- B. Locksets:
1. All locksets shall meet or exceed ANSI A156.13-94, Grade 1 requirements.
- C. Panic Devices:
1. All panic devices shall have touchbars made of stainless steel, provide devices in stainless finish where specified.
 2. All latchbolts are to be deadlatching.
- D. Closers:
1. Comply with manufacturer's recommendations for unit size based on door size, weather exposure and usage.
 2. Provide parallel arms for all overhead closers, except as otherwise indicated.
 3. All surface closers shall exceed ANSI A156.4 Grade 1 requirements in all aspects as called for below. All closers shall have certification by an independent testing laboratory of 10,000,000 cycles without failure. Provide special rust inhibitive primer (SRI) where specified.
 4. Furnish all brackets, drop plates and any other necessary hardware required to insure proper installation.
- E. Thresholds and Gasketing
1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
 2. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
 3. Gasketing and astragals on aluminum frames by door manufacturer.
- F. Silencers
1. Provide "push-in" type silencers for hollow metal or wood frames.
 2. Provide one silencer per 30 inches of height on each single frame, and two for each pair frame.
 3. Omit where gasketing is specified.

2.3 KEYING

- A. All cylinders to be keyed to the districts existing Best master system. Hardware supplier to verify proper key system. Keying schedule must be approved by the Owner prior to ordering locks.
 - 1. Hardware supplier shall be responsible for providing the correct type of cylinder for each hardware application, and supplying cylinder with correct tailpiece and/or cam.
 - 2. Provide removable cores where specified.
- B. Key all locks separately, or alike, as directed by the Owner's representative and Architect. D. Provide keys as follows:
 - 1. Change Keys: Two (2) per lock.
 - 2. Master Keys: Six (6) required (per system).
- C. Identification: Stamp all (master-type) keys with the following:
 - 1. Do Not Duplicate.
 - 2. Key change number (all keys).

2.4 HARDWARE FINISHES

- A. Provide matching finishes for hardware units at each door to the greatest extent possible, unless otherwise indicated. In general, match items to the finish for the latch, lock or push-pull unit for color and texture.
 - a. Product description or schedule:
 - 1) 626 satin chrome-plated.
 - 2) 630 satin stainless steel.

2.5 HARDWARE PRODUCTS

- A. Hinges:
 - 1. Specified manufacturer: IVES Hardware; an Allegion Company.
 - 2. Acceptable substitutions:
 - a. Hager Companies.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
 - c. Stanley Commercial Hardware; Div. of The Stanley Works.
- B. Continuous Gear-Type Hinges:
 - 1. Specified manufacturer: IVES Hardware; an Allegion Company.
 - 2. Acceptable substitutions:
 - a. Hager Companies.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
 - c. Select Products Limited.
- C. Locksets:
 - 1. Specified manufacturer: Best Lock.
 - 2. Substitutions: Not allowed. Products to match District standard.
- D. Exit Devices:
 - 1. Specified manufacturer: Von Duprin; an Allegion Company
 - 2. Substitutions: Not allowed. Products to match District standard.
- E. Closers:
 - 1. Specified manufacturer: LCN Closers; an Allegion Company.
 - 2. Substitutions: Not allowed. Products to match District standard.
- F. Flatgoods:
 - 1. Specified manufacturer: Ives Hardware; an Allegion Company.
 - 2. Acceptable substitutions:
 - a. Burns.
 - b. Rockwood.
- G. Stops:
 - 1. Specified manufacturer: Ives Hardware; an Allegion Company.
 - 2. Acceptable substitutions:
 - a. Burns Manufacturing Incorporated.
 - b. Hager Companies.
 - c. Rockwood Manufacturing Company.

- d. Trimco
- H. Overhead stops:
 - 1. Specified manufacturer: Glynn-Johnson; an Allegion Company.
 - 2. Acceptable substitutions:
 - a. Architectural Builders Hardware Mfg., Inc.
 - b. Door Controls International.
 - c. Ives Hardware; an Allegion Company.
 - d. Rixson Specialty Door Controls; an ASSA ABLOY Group.
 - e. Trimco.
- I. Thresholds:
 - 1. Specified manufacturer: Zero International
 - 2. Acceptable substitutions:
 - a. Pemko Manufacturing Co.
 - b. Reese Enterprises.
 - c. National Guard Products.
- J. Door Gasketing:
 - 1. Specified manufacturer: Zero International
 - 2. Acceptable substitutions:
 - a. Pemko Manufacturing Co.
 - b. Reese Enterprises.
 - c. National Guard Products.
- K. Weatherstripping:
 - 1. Specified manufacturer: Zero International
 - 2. Acceptable substitutions:
 - a. Pemko Manufacturing Co.
 - b. Reese Enterprises.
 - c. National Guard Products.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Carefully inspect doors, frames, and conditions under which hardware will be installed. Notify the Architect of any conditions that would adversely affect the installation or subsequent door operations. Do not proceed until unsatisfactory conditions are corrected.
 - 1. Frames shall be verified, inspected, and confirmed by General Contractor as being plumb and true.
- B. Refer to Sections 081113, 081416, and 084113 for additional installation requirements.
- C. Prior to hardware installation, the Hardware Supplier shall meet with the Owner's Representative, Architect, and Hardware Installer to ensure the Installer has and understands the manufacturers' installation requirements for all hardware items.
 - 1. The Supplier shall observe the installation of the first lockset, closer and panic device.

3.2 INSTALLATION

- A. Mount Hardware units at heights indicated in respective DHI Standards, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.
- B. Install each hardware item in compliance with the manufacturer's instructions and written recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be field finished, coordinate removal, storage and reinstallation or application of surface protections with finishing work. Do not install surface-mounted items until finishes have been completed on the substrate.
- C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
 - 1. Special care shall be taken to avoid damaging surrounding surfaces.

- D. Provide fasteners and anchoring devices of suitable size, quantity, and type to secure hardware in proper position for heavy use and long life.
 - 1. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Adjust door closers immediately upon installation. Adjust in exact conformance with manufacturer's printed instructions. Advance backcheck to eliminate shock at dead stop. Set latching speed to assure unassisted positive latching.
 - 1. Degrees of swing of doors for self-limiting closers shall be maximum available.
- F. Install each protection plate with a thinly-spread spot of mastic at its center to assure even contact before fastening with screws. Install all such plates on visual centers of closed doors. Set bottom edges of all such plates flush with door bottom.
- G. Cut and fit thresholds to door frame profiles. Prepare thresholds for the attachment of strikes and clearance for spindles as required. Set thresholds in a continuously laid bed of polyisobutylene mastic sealant to completely fill voids and exclude moisture from every source.
- H. Seal weather protection components attached to the exterior sides of doors and frames, such as drip caps and weatherstripping, in place with clear silicone caulk in such a manner as to ensure a continuously filled seam throughout the joinery.
- I. Cut and fit weatherstripping accurately to provide the greatest possible continuity of the contact element. Adjust closer templating as required.
- J. At exterior doors, obtain satisfactory operation of the installation, then apply a thin layer of clear silicone caulk under hinge leaves, and outside lock trim. Remove excess caulk after torquing fasteners.

3.3 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
 - 1. Clean adjacent surfaces soiled by hardware installation.
- B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.4 INSTRUCTION AND INSPECTION

- A. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.
- B. After hardware is installed and adjusted, the Supplier shall inspect the job with the Architect and the Contractor to determine if the hardware is functioning properly.
 - 1. Maintain the instruction sheets, layout templates, and any supplementary literature regarding hardware in a readable condition. Transmit all such items to the Owner's Representative, together with all spare parts, specialized tools, other accessories supplied with the hardware, and a copy of the approved hardware schedule at the time of instruction.
- C. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units at no cost to the Owner. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

HARDWARE SET 01

DOOR NUMBER:

A108B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-DT	626	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74 X VERIFY CAM	626	BES
2	EA	SURFACE CLOSER	4111 AVB SCUSH	689	LCN
1	EA	GASKETING	429A	A	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	ASTRAGAL SET	8195AA	AA	ZER
2	EA	THRESHOLD	65A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS904 900-2RS	LGR	SCE
1	EA	DIAGRAM	WIRING DIAGRAMS		
1			CARD READER BY OTHERS		
1	EA		WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS VIA VALID CARD READ. PANICS MAY BE DOGGED (MADE PUSH/PULL) ELECTRONICALLY OR VIA HEX DOGGING. ALWAYS FREE EGRESS.

NOTE: INSTALL WEATHERSTRIP AT FRAME HEAD FIRST, THEN INSTALL CLOSER PA BRACKET ON WEATHERSTRIP.

HARDWARE SET 02

DOOR NUMBER:

1033A 198.1A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 AVB SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4110-61 (IF REQ'D)	689	LCN
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	65A-MSLA-10	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-BBK 900-2RS-FA	LGR	SCE
1	EA	DIAGRAM	WIRING DIAGRAMS		
1			CARD READER BY OTHERS		
1	EA		WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED, UNLESS PANIC IS DOGGED (MADE PUSH/PULL) ELECTRONICALLY OR VIA HEX DOGGING. WHEN LOCKED, ENTRY BY VALID CARD READ. ALWAYS FREE EGRESS.

HARDWARE SET 02A

DOOR NUMBER:

T109 T111A T111B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-DT	626	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74 X VERIFY CAM	626	BES
2	EA	SURFACE CLOSER	4111 AVB CUSH	689	LCN
2	EA	MOUNTING PLATE	4110-18 (IF REQ'D)	689	LCN
2	EA	CUSH SHOE SUPPORT	4110-30 (IF REQ'D)	689	LCN
2	EA	BLADE STOP SPACER	4110-61 (IF REQ'D)	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
2	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	65A-MSLA-10	A	ZER
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS904 BBK 900-2RS 120/240 VAC	LGR	SCE
1	EA	DIAGRAM	WIRING DIAGRAMS		
1			CARD READER BY OTHERS		
1	EA		WEATHERSTRIP BY DOOR/FRAME		
			MANUFACTURER		

OPERATION: DOORS NORMALLY CLOSED AND LOCKED, UNLESS PANICS ARE DOGGED (MADE PUSH/PULL) ELECTRONICALLY OR VIA HEX DOGGING. WHEN LOCKED, ENTRY BY VALID CARD READ. ALWAYS FREE EGRESS.

HARDWARE SET 03

DOOR NUMBER:

1033B 1033C 1033D 1033E 198.1B 198.1C
 198.1D

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-DT	626	VON
1	EA	SURFACE CLOSER	4111 AVB SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4110-61 (IF REQ'D)	689	LCN
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	65A-MSLA-10	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-BBK 900-2RS-FA	LGR	SCE
1	EA	DIAGRAM	WIRING DIAGRAMS		
1	EA		WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED, UNLESS PANIC IS DOGGED (MADE PUSH/PULL) ELECTRONICALLY OR VIA HEX DOGGING. ALWAYS FREE EGRESS.

HARDWARE SET 03A

DOOR NUMBER:

T134

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	CLASSROOM LOCKSET	93K7R 15D	626	BES
1	EA	SURFACE CLOSER	4111 AVB SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4110-61 (IF REQ'D)	689	LCN
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	65A-MSLA-10	A	ZER
1	EA		WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

NOTE: KEYED SIDE OF LOCKSET TO BE ON INTERIOR OF BUILDING, RESTRICTING ACCESS TO COURTYARD. OUTSIDE LEVER ALWAYS FREE EGRESS BACK INTO BUILDING.

HARDWARE SET 04

DOOR NUMBER:

1032B 1032C 1032D 1032E 198.2B 198.2C
 198.2D

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-DT	626	VON
1	EA	SURFACE CLOSER	4111 AVB SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4110-61 (IF REQ'D)	689	LCN
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-BBK 900-2RS-FA	LGR	SCE
1	EA	DIAGRAM	WIRING DIAGRAMS		
1	EA		WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED, UNLESS PANIC IS DOGGED (MADE PUSH/PULL) ELECTRONICALLY OR VIA HEX DOGGING. ALWAYS FREE EGRESS.

HARDWARE SET 05

DOOR NUMBER:

1032A 198.2A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	HD-RX-LC-QEL-99-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 AVB SCUSH	689	LCN
1	EA	MOUNTING PLATE	4110-18 (IF REQ'D)	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4110-61 (IF REQ'D)	689	LCN
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-BBK 900-2RS-FA	LGR	SCE
1	EA	DIAGRAM	WIRING DIAGRAMS		
1	EA		WEATHERSTRIP BY DOOR/FRAME MANUFACTURER		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED, UNLESS PANIC IS DOGGED (MADE PUSH/PULL) ELECTRONICALLY OR VIA HEX DOGGING. ALWAYS FREE EGRESS.

HARDWARE SET 06

DOOR NUMBER:

A104

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-L-996-06	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 DEL EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	WALL MAG HOLDER	SEM7850	689	LCN
1	EA	GASKETING	8144SBK PSA	BK	ZER

HARDWARE SET 07

DOOR NUMBER:

A108A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASS SEC PANIC HARDWARE	99-L-2SI-996-06	626	VON
2	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4111 DEL EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	170AA-S	AA	ZER
1	EA	DOOR BOTTOM	361AA	AA	ZER
1	EA	THRESHOLD	1/4" SMOOTH, OFFSET OR FLAT AS REQ'D FOR FLOOR CONDITION		
2	EA	MOUNTING BRACKET	770SPB (FOR CLOSER PA BRACKET/RIM PANIC STRIKE)		ZER

HARDWARE SET 08

DOOR NUMBER:
200A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCKSET	93K7D 15D	626	BES
1	EA	ELECTRIC STRIKE	6211 FSE	630	VON
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	REQUEST-TO-EXIT MOTION SCANNER	SCANII	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE
	EA	NOTE	CARD ACCESS BY OTHERS		

OPERATION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY VIA VALID CARD READ. INSIDE LEVER ALWAYS FREE EGRESS. ELECTRIC STRIKE TO ALSO BE CAPABLE OF REMOTE RELEASE BY PUSHBUTTON AT RECEPTION. PUSHBUTTON BY ACCESS CONTROL PROVIDER.

HARDWARE SET 09

DOOR NUMBER:
200B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSRM X STORERM LOCK	93K7DR 15D	626	BES
1	EA	ELECTRIC STRIKE	6211 FSE	630	VON
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE
	EA	NOTE	CARD ACCESS BY OTHERS		

OPERATION: DOOR ALWAYS CLOSED AND LOCKED ON OFFICE SIDE. LEVER ON CORRIDOR SIDE CAN BE LEFT UNLOCKED BY KEY. ACCESS FROM OFFICE TO CORRIDOR VIA VALID CARD READ. ELECTRIC STRIKE TO ALSO BE CAPABLE OF REMOTE RELEASE BY PUSHBUTTON AT RECEPTION, ALLOWING VISITOR ACCESS INTO CORRIDOR. PUSHBUTTON BY ACCESS CONTROL PROVIDER.

HARDWARE SET 10

DOOR NUMBER:

1034A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	STOREROOM LOCKSET	93K7D 15D	626	BES
1	EA	ELECTRIC STRIKE	6211AL FSE	630	VON
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4011 (W/ SPECIAL TEMPLATE ST-1544)	689	LCN
1	EA	MOUNTING PLATE	4020-18	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	REQUEST-TO-EXIT MOTION SCANNER	SCANII	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE
	EA	NOTE	CARD ACCESS BY OTHERS		

OPERATION: DOOR ALWAYS CLOSED AND LOCKED ON VESTIBULE SIDE. ENTRY TO OFFICE VIA VALID CARD READ. INSIDE LEVER ALWAYS FREE EGRESS. ELECTRIC STRIKE TO ALSO BE CAPABLE OF REMOTE RELEASE BY PUSHBUTTON AT RECEPTION, ALLOWING VISITOR ACCESS INTO OFFICE. PUSHBUTTON BY ACCESS CONTROL PROVIDER.

HARDWARE SET 11

DOOR NUMBER:

1034B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	CLASSRM X STORERM LOCK	93K7DR 15D	626	BES
1	EA	ELECTRIC STRIKE	6211AL FSE	630	VON
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 (IF REQ'D)	689	LCN
1	EA	BLADE STOP SPACER	4110-61 (IF REQ'D)	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	DOOR CONTACT	679-05	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	SCE
	EA	NOTE	CARD ACCESS BY OTHERS		

OPERATION: DOOR ALWAYS CLOSED AND LOCKED ON OFFICE SIDE. LEVER ON CORRIDOR SIDE CAN BE LEFT UNLOCKED BY KEY. ACCESS FROM OFFICE TO CORRIDOR VIA VALID CARD READ. ELECTRIC STRIKE TO ALSO BE CAPABLE OF REMOTE RELEASE BY PUSHBUTTON AT RECEPTION, ALLOWING VISITOR ACCESS INTO CORRIDOR. PUSHBUTTON BY ACCESS CONTROL PROVIDER.

HARDWARE SET 12

DOOR NUMBER:

A106 A109

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCKSET	93K7R 15D	626	BES
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

NOTE: PROVIDE FLOOR STOP IN LIEU OF WALL STOP WHERE REQUIRED.

HARDWARE SET 14

DOOR NUMBER:

A107A A107B

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCKSET	93K7R 15D (EXTENDED BACKSET IF REQUIRED)	626	BES
1	EA	SURFACE OH STOP	90S	630	GLY
1	EA	GASKETING	170AA-S	AA	ZER
1	EA	DOOR BOTTOM	361AA	AA	ZER
1	EA	THRESHOLD	1/4" SMOOTH, OFFSET OR FLAT AS REQ'D FOR FLOOR CONDITION		
1	EA	MOUNTING BRACKET	770SPB (FOR OH STOP)		ZER

HARDWARE SET 15

DOOR NUMBER:

A101 A102 A103

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PASSAGE LOCKSET	93KON 15D (EXTENDED BACKSET IF REQUIRED)	626	BES
1	EA	SURFACE CLOSER	4011 DEL	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/438	626	IVE
1	EA	GASKETING	170AA-S	AA	ZER
1	EA	DOOR BOTTOM	361AA	AA	ZER
1	EA	THRESHOLD	1/4" SMOOTH, OFFSET OR FLAT AS REQ'D FOR FLOOR CONDITION		

HARDWARE SET 16

DOOR NUMBER:

268A 268B T130

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
			RELOCATED DOOR, FRAME, AND HARDWARE		

HARDWARE SET 17

DOOR NUMBER:
N024 S131

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CLASSROOM LOCKSET	93K7R 15D	626	BES
1	EA	MAGNETIC LOCK	M490P TJ490 12/24 VDC	628	SCE
1	EA	PUSH BUTTON	621RDEX DA 12/24 VDC	630	SCE
1	EA	REQUEST-TO-EXIT MOTION SCANNER	SCANII	WHT	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS-FA 120/240 VAC	LGR	SCE
1	EA	DIAGRAM	WIRING DIAGRAMS		
1			CARD READER BY OTHERS		

OPERATION: DOOR ALWAYS CLOSED AND LOCKED. ENTRY BY EXTERIOR CARD READER, MOMENTARILY RELEASING MAGNETIC LOCK. FREE EGRESS AT ALL TIMES BY REQUEST TO EXIT MOTION SCANNER, WHICH AUTOMATICALLY RELEASES MAGNETIC LOCK WHEN OCCUPANT APPROACHES FOR EGRESS. WALL MOUNT PUSHBUTTON DIRECTLY INTERRUPTS POWER TO MAGNET FOR MINIMUM OF 30 SECONDS IN CASE OF MOTION SCANNER FAILURE. MAGNETIC LOCK TO ALSO AUTOMATICALLY RELEASE UPON FIRE ALARM ACTIVATION.

BALANCE OF HARDWARE IS EXISTING AND TO REMAIN.

EXAMINE EXISTING DOOR/FRAME CONDITION PRIOR TO ORDERING HARDWARE. IF EXISTING CONDITIONS PROHIBIT THE PRACTICAL INSTALLATION OF THE ABOVE SCHEDULED HARDWARE, NOTIFY CONTRACTOR

HARDWARE SET 18

DOOR NUMBER:
W100

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	DOOR CORD	788C-12/18 AS REQ'D	626	SCE
2	EA	LATCH RETRACTION KIT	EL KIT-HD-QEL-MODULAR CONVERSION- 24VDC		VON
2	EA	SWITCH	SWITCH KIT-RX-LC		VON
2	EA	DOOR CONTACT	7766	628	SCE
1	EA	POWER SUPPLY	PS904 900-2RS-FA	LGR	VON
1	EA	DIAGRAM	WIRING DIAGRAMS		
1			CARD READER BY OTHERS		

OPERATION: DOORS ALWAYS CLOSED AND LOCKED, UNLESS DOGGED ELECTRONICALLY VIA ACCESS CONTROL SYSTEM OR HEX KEY. WHEN LOCKED, ENTRY BY EXTERIOR CARD READER, MOMENTARILY RETRACTING DEVICE LATCHES. INSIDE PUSH PADS ALWAYS FREE EGRESS

BALANCE OF HARDWARE IS EXISTING AND TO REMAIN.

EXAMINE EXISTING DOOR/FRAME CONDITION PRIOR TO ORDERING HARDWARE. IF EXISTING CONDITIONS PROHIBIT THE PRACTICAL INSTALLATION OF THE ABOVE SCHEDULED HARDWARE, NOTIFY CONTRACTOR.

HARDWARE SET 19

DOOR NUMBER:

A105

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCKSET	93K7R 15D (EXTENDED BACKSET IF REQUIRED)	626	BES
1	EA	SURFACE CLOSER	4111 DEL CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	170AA-S	AA	ZER
1	EA	DOOR BOTTOM	361AA	AA	ZER
1	EA	THRESHOLD	1/4" SMOOTH, OFFSET OR FLAT AS REQ'D FOR FLOOR CONDITION		
1	EA	MOUNTING BRACKET	770SPB		ZER

DOOR/HARDWARE INDEX

RAYTOWN MISC SCHOOLS

Door #	HWSet #
N024	17
S131	17
T109	02A
T111A	02A
T111B	02A
T130	16
T134	03A
W100	18

RAYTOWN MIDDLE SCHOOL

Door #	HWSet #
1032A	05
1032b	04
1032c	04
1032d	04
1032E	04
1033A	02
1033b	03
1033c	03
1033d	03
1033E	03
1034a	10
1034b	11
A101	15
A102	15
A103	15
A104	06
A105	19
A106	12
A107a	14
A107b	14

Door #	HWSet #
A108a	07
A108b	01
A109	12

RAYTOWN SOUTH HIGH SCHOOL

Door #	HWSet #
198.1A	02
198.1b	03
198.1c	03
198.1D	03
198.2A	05
198.2b	04
198.2c	04
198.2D	04
200A	08
200B	09
268A	16
268B	16

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Windows.
 - 2. Doors.
 - 3. Storefront framing.
 - 4. Interior borrowed lites.
- B. Related Sections:
 - 1. Section 081113 "Hollow Metal Doors and Frames."
 - 2. Section 084113 "Aluminum Entrances and Storefronts."

1.2 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM E 119: Fire Tests of Building Construction and Materials.
- B. American National Standards Institute (ANSI):
 - 1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings.
- C. Consumer Product Safety Commission (CPSC):
 - 1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials, Category II.

1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

- C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.
- B. Qualification Data: For Installers.

1.7 CLOSEOUT SUBMITTALS

- A. Warranties: Sample of special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.
- E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- G. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- I. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts" to match glazing systems required for Project, including glazing methods.

1.9 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.
 - 3. Review drawings for locations and details of glazing.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.12 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
 - 1. Design Wind Pressures: As indicated on Drawings.
 - 2. Design Snow Loads: As indicated on Drawings.
 - 3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 - 4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
 - 5. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 GLASS PRODUCTS, GENERAL

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 - 1. Obtain tinted glass from single source from single manufacturer.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

- C. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.
- E. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: 6.0 mm, except where specifically indicated otherwise.
- F. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- G. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 - 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
 - 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
 - 1. Glass Types: Refer to Glass Type Schedule at end of this Section.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Low-E-Coated Vision Glass: Coated by pyrolytic process or vacuum deposition (sputter-coating) process, and complying with other requirements specified.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide products listed below or comparable products from other manufacturers meeting specified requirements, and which are submitted to and accepted by Architect prior to bidding.
 - a. Guardian Sunguard; "SuperNeutral 68 - Clear".
 - 2. Kind: Kind CV (coated vision glass).
 - 3. Glass: Clear and tinted float. Refer to Glass Types Schedule at end of this Section.
 - 4. Performance Criteria: Refer to Glass Types Schedule at end of this Section.

2.4 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
 - 1. Sealing System: Dual seal, with polyisobutylene and silicone, primary and secondary seals, respectively.
 - 2. Spacer: Aluminum with "black" anodic finish.
 - 3. Desiccant: Molecular sieve or silica gel, or blend of both.
- B. Glass Types: Refer to Glass Type Schedule at end of this Section.

2.5 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. EPDM complying with ASTM C 864.
 - 2. Silicone complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM or silicone gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

2.7 GLAZING TAPES

- A. General: Provide glazing tapes that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
- B. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- C. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General:
 - 1. Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
 - 2. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.
 1. Provide ground and polished edges for glass doors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Presence and functioning of weep systems.
 3. Minimum required face and edge clearances.
 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- F. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

3.8 GLASS TYPE SCHEDULE - MONOLITHIC-GLASS

- A. Glass Type 5 - Clear float glass (088000.A01):
 - 1. Thicknesses:
 - a. 3/8 inch (9.5 mm).
- B. Glass Type 6 - Clear fully tempered float glass (088000.A02):
 - 1. Thicknesses:
 - a. 3/8 inch (9.5 mm).
 - 2. Provide safety glazing labeling.

3.9 GLASS TYPE SCHEDULE – INSULATING GLASS

- A. Glass Type 9 - Low-E-clear insulating glass (088000.A17):
 - 1. Overall Unit Thickness: 1 inch.
 - 2. Thickness of Each Glass Lite: 6.0 mm.
 - 3. Outdoor Lite: Heat strengthened float glass.
 - a. Basis-of-Design Product: Guardian Sunguard; “SuperNeutral 68 - Clear”.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Heat strengthened low-E coated (sputter-coated) float glass.
 - 6. Low-E Coating: Sputtered third surface.
 - 7. Safety glazing required. Provide safety glazing labeling.
 - 8. Visible Light Transmittance: 68 percent minimum.
 - 9. Visible Light Reflectance (out): 11 percent.
 - 10. Winter Nighttime U-Factor: 0.29 maximum.
 - 11. Solar Heat Gain Coefficient: 0.38 maximum.
 - 12. Light to Solar Gain Ratio (LSG): Not less than 1.80.

- B. Glass Type 10 - Low-E-clear, tempered insulating glass (088000.A18):
1. Overall Unit Thickness: 1 inch.
 2. Thickness of Each Glass Lite: 6.0 mm.
 3. Outdoor Lite: Fully tempered clear sputter-coated float glass.
 - a. Basis-of-Design Product: Guardian Sunguard; "SuperNeutral 68 - Clear".
 4. Interspace Content: Air.
 5. Indoor Lite: Heat strengthened low-E coated (sputter-coated) float glass.
 6. Low-E Coating: Sputtered third surface.
 7. Safety glazing required. Provide safety glazing labeling.
 8. Visible Light Transmittance: 68 percent minimum.
 9. Visible Light Reflectance (out): 11 percent.
 10. Winter Nighttime U-Factor: 0.29 maximum.
 11. Solar Heat Gain Coefficient: 0.38 maximum.
 12. Light to Solar Gain Ratio (LSG): Not less than 1.80.

END OF SECTION 088000

SECTION 092116 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions (092116.A01).
 - 2. Suspension systems for interior ceilings, bulkheads, soffits, and exterior soffits.
 - a. For spans exceeding 8 feet in any direction without intermediate supports, refer to Section 054000 for design requirements.
 - 3. Grid suspension systems for gypsum board ceilings.
- B. Related Requirements:
 - 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; ceiling joists. In addition, for all interior soffits and ceilings where span in any direction exceeds 8 feet without intermediate supports.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For embossed steel studs and runners and firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Horizontal Deflection: For wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40 or coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners (092116.A01): ASTM C 645. Use either steel studs and runners or embossed steel studs and runners.
 - 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.0179 inch.
 - b. Provide 0.0329 inch minimum base metal thickness for studs and runners at walls indicated to receive tile, walls indicated to receive impact-resistant drywall, and at other locations indicated.
 - c. Depth: 3-5/8 inches, unless otherwise indicated.
 - 2. Embossed Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.0147 inch.
 - b. Provide 0.025 inch minimum base metal thickness for studs and runners at walls indicated to receive tile, walls indicated to receive abrasion-resistant drywall, impact-resistant drywall, and at other locations indicated.
 - c. Depth: 3-5/8 inches, unless specifically indicated otherwise.

- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit over inside runner and one gauge heavier than gauge for wall construction indicated.
 - 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.0329 inch.
- E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels (092116.A02): ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.0179 inch.
 - 2. Depth: 7/8 inch, unless specifically indicated otherwise.
- G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: 3/4 inch.
 - 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E488.
 - a. Type: Post installed, chemical anchor or post-installed, expansion anchor.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges. Hot-dip galvanize carrying channels in exterior locations to at least G40 requirements.
 - 1. Depth: 2 inches.
- F. Furring Channels (Furring Members) (092116.A05):
 - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch.
 - b. Depth: 2-1/2 inches.
 - 3. Embossed Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0147 inch.
 - b. Depth: 2-1/2 inches.
 - 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.0179 inch.

- G. Grid Suspension System for Gypsum Board Ceilings: At Contractor's option, pre-manufactured grid suspension systems may be used. Grid suspension system shall comply with ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc; "Drywall Grid Systems" or comparable system meeting specified requirements from the following:
 - a. Chicago Metallic Corporation.
 - b. United State Gypsum Company.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Vertical Isolation Strips at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
- C. Isolation Strips beneath Runner Tracks at Exterior Walls: Provide the following:
 - 1. Polyethylene-sheet-backed rubberized asphalt membrane, 40 mils thick. Field cut to match widths of runners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.

3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
 - C. Where runner tracks for exterior walls are installed directly against concrete or dissimilar metals, install rubberized asphalt isolation strips between bottom of runner track and concrete.
 - D. Install studs so flanges within framing system point in same direction.
 - E. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs, having a minimum base metal thickness of 0.0329 inches, at each jamb.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - F. Direct Furring:
 1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Hangers: 48 inches o.c.
 2. Carrying Channels (Main Runners): 48 inches o.c.
 3. Furring Channels (Furring Members): 16 inches o.c.
- B. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

- 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- C. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092116

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board Type X (092900.A02).
 - 2. Impact-Resistant Gypsum board (092900.A05).
 - 3. Mold and Moisture Resistant Gypsum Board (092900.A06).
 - 4. Expansion control joint (092900.A12).
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
 - 2. Section 092116 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
 - 3. Section 095113 "Acoustical Panel Ceilings" for transitions moldings from ACT to gypsum board.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 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 E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Lafarge North America, Inc.
 - 4. National Gypsum Company.
 - 5. Pabco Gypsum.
 - 6. USG Corporation.
- B. Gypsum Board, Type X (092900.A02): ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- C. Abuse/Impact-Resistant Gypsum Board (092900.A05): ASTM C 1629/C 1629M.
 - 1. Core: 5/8 inch, Type X.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 - 4. Physical Properties when tested in accordance with ASTM C 1629:
 - a. Surface Abrasion Resistance: Level 3.
 - b. Indentation Resistance: Level 1, minimum.
 - c. Soft-Body Impact Resistance: Level 3.
 - d. Hard-Body Impact Resistance: Level 3.
- D. Mold-Resistant Gypsum Board (092900.A06): ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 - 1. Core: 5/8 inch, Type X.
 - 2. Long Edges: Tapered.
 - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Glass-Mat Gypsum Sheathing Board (092900.A09): ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.; GlasRoc Sheathing.
 - b. Georgia-Pacific Building Products.; Dens-Glass Gold.
 - c. National Gypsum Company.; Gold Bond, eXP
 - d. USG Corporation.; Securock Glass Mat Sheathing
 - 2. Core: 5/8 inch, Type X.

2.5 TRIM ACCESSORIES

- A. Gypsum Board Trim (092900.A11): ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - a. At Contractor's option, interior gypsum board trim may be a structural laminate drywall corner system using "No-Coat" products as manufactured by Structus or a comparable product submitted to and accepted by Architect prior to bidding.
 - 2. Shapes:
 - a. Cornerbead.
 - b. L-Bead: L-shaped; exposed long flange receives joint compound.
 - c. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - d. Expansion (control) joint.
 - e. Wall end cap: Provide "Fast Cap" as manufactured by Trim-Tex Drywall Products.
 - f. Transition Molding: Refer to Section 095113.

2.6 TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.

2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
 - a. Where specifically indicated on Drawings, provide a setting-type, sandable topping compound for trowel-applied skim coat.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Sound-Attenuation Blankets (092900.A14): ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant (092900.A15): Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Accumetric LLC.; BOSS 824 Acoustical Sound Sealant.
 - b. Pecora Corporation.; AIS-919.
 - c. USG Corporation.; SHEETROCK Acoustical Sealant.
 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- G. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."
- H. Waterproofing Membrane – General: Manufacturer's standard product, selected from the following that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
1. Chlorinated Polyethylene Sheet: Non-plasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
 2. PVC Sheet: Two layers of PVC sheet heat-fused together and to facings of nonwoven polyester; 0.040-inch nominal thickness.
 3. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
 - 4. Where ceilings in showers abut adjacent walls, Provide 1/4- to 3/8-inch-wide spaces and trim edges with plastic edge trim to allow for sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical and horizontal surfaces of walls, soffits, bulkheads and ceiling surfaces unless otherwise indicated.
 - 2. Abuse/Impact-Resistant Type: Refer to Drawings for locations required.
 - 3. Moisture and Mold Resistant Type X: Exterior walls and restrooms, except at walls indicated to receive tile. Restrooms and wet walls (such as behind electric drinking fountains, behind janitor's sink and sinks).

- B. Single-Layer Application:
 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
- D. Curved Surfaces:
 1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Gypsum Board Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. L-Bead: Use where indicated.
 3. U-Bead: Use at exposed panel edges.
- D. Interior Gypsum Board Trim (Contractor's Option)– Structural Laminate: Provide at all outside corners within 8'-0" of floor surface.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Division 09 Sections.
 - 1. Level 5: Where indicated on Drawings and at locations behind vinyl film graphic signage, wallcovering, behind areas to receive dry erase paint, and at walls perpendicular to exterior glazing.
 - a. Primer and its application to surfaces are specified in Other Division 09 Sections.
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceramic tile (093000.A01).
 - 2. Crack isolation and waterproofing membrane.
 - 3. Metal edge strips (093000.A04).
- B. Related Sections:
 - 1. Section 079200 "Joint Sealants" for sealing of expansion, control, and isolation joints in tile surfaces.
 - 2. Section 092900 "Gypsum Board" for tile backer board.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section, unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Face Size: Actual tile size, excluding spacer lugs.
- D. Module Size: Actual tile size plus joint width indicated.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Full-size units of each type of trim and accessory for each color and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
 - 1. Crack isolation membrane.
 - 2. Joint sealants.
 - 3. Metal edge strips.
- D. Mockups/Field Samples: Build mockups/field samples to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups/field samples of each type of restroom wall tile installation.
 - 2. Approved mockups/field samples may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained, and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

- A. Tile Type (093000.A01 – T1, T2, T3): Glazed ceramic wall tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide “Ever” by Daltile.
 2. Composition: porcelain.
 3. Module Size: As indicated on Material Finish Legend.
 4. Thickness: 5/16 inch.
 5. Face: Plain.
 6. Surface: Smooth, Gloss.
 7. Tile Color and Pattern: As indicated by manufacturer's designations on Material Finish Legend.
 8. Grout Color: As indicated by manufacturer's designations on Material Finish Legend
 9. Bullnose Corners: As indicated on Drawings.
- B. Tile Type (093000.A01 – T4, T5, T6): Glazed ceramic wall tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide “Terra Tones” by Mosa.
 2. Composition: Porcelain.
 3. Module Size: As indicated on Material Finish Legend.
 4. Finish: As selected by Architect from manufacturer's full range.
 5. Tile Color and Pattern: As indicated by manufacturer's designations on Material Finish Legend.
 6. Grout Color: As indicated by manufacturer's designations on Material Finish Legend
 7. Bullnose Corners: As indicated on Drawings.
- C. Tile Type (093000.A01 – TB1): Glazed ceramic wall tile.
1. Basis-of-Design Product: Subject to compliance with requirements, provide “Color by Numbers – Crossville series” by Virginia Tile.
 2. Composition: Porcelain.
 3. Module Size: As indicated on Material Finish Legend.
 4. Thickness: 1/4 inch.
 5. Face: Plain, with cushion edges.
 6. Surface: Smooth, satin.
 7. Finish: As selected by Architect from manufacturer's full range.
 8. Tile Color and Pattern: As indicated by manufacturer's designations on Material Finish Legend.
 9. Grout Color: As indicated by manufacturer's designations on Material Finish Legend
 10. Bullnose Corners: left and right outside corners as required.

2.3 SETTING MATERIALS

- A. Improved Modified Dry-Set Mortar (Thinset and LHT Mortars): ANSI A118.15.
1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.
- B. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.
1. Provide pre-packaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

2.4 GROUT MATERIALS

- A. Water-Cleanable High Performance Epoxy Grout: ANSI A118.3, with a working time not less than 80 minutes, equipped with anti-microbial technology and a full cure time of 14 days at 70 degrees F.
 - 1. Basis-of-Design Product: TEC, "AccuColor EFX Special Effects Grout" or comparable product from other manufacturers listed below, meeting specified requirements, submitted to and accepted by Architect prior to bidding.
 - a. Bostik, Inc.
 - b. Custom Building Products.
 - c. Laticrete International, Inc.
 - d. Mer-Kote Products, Inc.
 - e. Southern Grouts & Mortars, Inc.
 - f. Summitville Tiles, Inc.
 - g. MAPEI.
 - 2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg. F. and 212 deg. F., respectively, and certified by manufacturer for intended use.

2.5 MISCELLANEOUS MATERIALS

- A. Fluid-Applied Waterproofing/Crack Isolation Membrane: Liquid-latex rubber or elastomeric polymer.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Laticrete; "Hydro Ban" waterproofing and crack isolation membrane. Comparable products from other manufacturers will be considered when submitted to and accepted by Architect prior to bidding.
 - 2. Product Description and Characteristics:
 - a. Single component, self-curing liquid rubber polymer that forms a flexible and seamless membrane.
 - b. Thickness: Not less than 0.020 inches when cured.
 - c. Anti-fracture protection up to 1/8 inch.
 - d. Extra Heavy Service rating per TCNA.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- C. Metal Edge Strips (093000.A04): Flush mount edge strip as indicated by manufacturer to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; white zinc alloy or stainless-steel, ASTM A 666, 300 Series exposed-edge material. Provide the following metal edge strips:
 - 1. Type – Schluter; JOLLY at bottom of tile transitions. Unless noted on the Material Finish Legend color shall be selected by Architect from manufacturers full range of options.
 - a. Provide at top and base of all tile installations.
 - 2. Type – Schluter; QUADDEC edge at all tile outside corners. Unless noted on the Material Finish Legend color shall be selected by Architect from manufacturers full range of options.
 - a. Provide at all outside corners.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.6 MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, pre-coat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in pattern indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic: 1/16 inch.
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- I. Grout Sealer: Apply grout sealer to cementitious grout joints in the wainscot according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

- A. Install liquid waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install liquid crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior and Exterior Wall Installations, Metal Studs or Furring:
 - 1. Tile Installation: Thin-set mortar on cementitious backer unit; TCNA W244C-16.
 - a. Tile Type: T1, T2, T3, T4, T5, T6.
 - b. Thin-Set Mortar: Medium Bed, Latex-portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout.

3.7 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Acoustical ceiling panels (095113.A01).
 - 2. Ceiling suspension systems (095113.A02).
 - 3. Edge Molding and Trim (095113.A03).
 - 4. Decorative edge trim for ceilings. (095113.A04).
- B. Related Requirements:
 - 1. Section 092116 "Non-Structural Metal Framing".
 - 2. Section 092900 "Gypsum Board".

1.2 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: One 6-inch square Sample of each type, color, pattern, and texture.
 - 2. Decorative Edge Trim: One 6-inch-long Sample of each type, finish, and color. Include splice plate and attachment clip.

1.4 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. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 5. Perimeter moldings.
- B. Installer Qualifications: Submit written certification of compliance with requirements.
- C. Qualification Data: For testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.
- E. Product test reports.
- F. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Furnish two, un-opened boxes of each type installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.
 - 4. Impact Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Firm with not less than three years of successful experience in installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.
- B. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Section 01 31 00.
- C. Testing Agency Qualifications: Qualified according to NVLAP.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- E. Metal Suspension System Standard: Comply with ASTM C 635.

2.3 ACOUSTICAL PANELS (095113.A01)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product specified hereinafter or comparable product by one of the following:
 - 1. Acoustical Ceiling Units:
 - a. Armstrong World Industries, Inc.
 - b. CertainTeed Corp. / Ecophon.
 - c. USG Interiors, Inc.; Subsidiary of USG Corporation.
 - 2. Metal Suspension Systems, Edge Moldings and Decorative Edge Trim:
 - a. Armstrong World Industries, Inc.
 - b. CertainTeed Corp.
 - c. Chicago Metallic Corporation.
 - d. Gordon, Inc.
 - e. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as specified.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 ACOUSTICAL CEILING PANELS

- A. Acoustical Ceiling Panel, (095113.A01 – ACT1): Provide vinyl faced, square edge lay-in, ceiling panels with the following characteristics:
 - 1. ASTM E 1264 Classification: Type IV, Form 2, Pattern E.
 - 2. Size: 24" x 48" x 3/4".
 - 3. Color: White.
 - 4. Average light reflectance (LR): 0.83.
 - 5. Ceiling Attenuation class (AC): 40.
 - 6. Flame Spread/Fire Resistance: Class A.
 - 7. Antimicrobial: BioBlock+ or comparable from other listed manufacturers.
 - 8. Humidity Resistance: HumiGuard+ or comparable from other listed manufacturers.
 - 9. Product warranty: 30 years.
 - 10. Suspension grid type: 15/16.
 - 11. Basis of Design Product: Provide Armstrong "Clean Room VL", #870, or comparable products from manufacturers listed in Article 2.3 of this Section.

- B. Acoustical Ceiling Panel, (095113.A01 – ACT2): Provide fine textured, square edge lay-in, mineral fiber ceiling panels with the following characteristics:
1. ASTM E 1264 Classification: Type IV, Form 2, Pattern E.
 2. Size: 24" x 24" x 1".
 3. Color: White.
 4. Average light reflectance (LR): 0.90.
 5. Noise reduction coefficient (NRC): 0.85, minimum.
 6. Articulation class (AC): 170.
 7. Flame Spread/Fire Resistance: Class A.
 8. Humidity Resistance: BioBlock or comparable from other listed manufacturers.
 9. Product warranty: 30 years.
 10. Suspension grid type: 15/16.
 11. Basis of Design Product: Provide Armstrong "Calla", #2820, or comparable products from manufacturers listed in Article 2.3 of this Section.
- C. Acoustical Ceiling Panel, (095113.A01 – ACT3): Provide fine textured, square edge lay-in, mineral fiber ceiling panels with the following characteristics:
1. ASTM E 1264 Classification: Type IV, Form 2, Pattern E.
 2. Size: 24" x 48" x 1".
 3. Color: White.
 4. Average light reflectance (LR): 0.90.
 5. Noise reduction coefficient (NRC): 0.85, minimum.
 6. Articulation class (AC): 170.
 7. Flame Spread/Fire Resistance: Class A.
 8. Humidity Resistance: BioBlock or comparable from other listed manufacturers.
 9. Product warranty: 30 years.
 10. Suspension grid type: 15/16.
 11. Basis of Design Product: Provide Armstrong "Calla", #2821, or comparable products from manufacturers listed in Article 2.3 of this Section.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Post-installed expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- D. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

- E. Hold-Down Clips for Non-Fire-Resistance-Rated Ceilings: For vestibule ceilings adjacent to exterior doors, provide hold-down clips spaced 2'-0" o.c. on all cross-tees for a radius of 10 feet from center of door.
- F. Impact Clips: In all toilet and locker rooms, provide manufacturer's standard impact clip system design to absorb impact forces against lay-in panels.
- G. Hemmed Edge Molding: Provide prefinished edge molding of profiles indicated. Finish to match adjacent suspension grid.

2.6 METAL SUSPENSION SYSTEM (095113.A02)

- A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Steel cold-rolled sheet, except in kitchen and food preparation areas provide aluminum.
 - 5. Cap Finish: White.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 METAL EDGE MOLDINGS AND TRIM (095113.A03)

- 1. Basis of Design Product of Transition Molding: Subject to compliance with requirements provide Armstrong World Industries, "Transition Molding" acoustical to drywall transition molding; or comparable product by one of the following:
 - 2. Certainteed World Corporation
 - 3. Chicago Metallic Corporation.
 - 4. Fry Reglet Corporation.
 - 5. Gordon, Inc.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 - 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.8 DECORATIVE METAL EDGE MOLDINGS AND TRIM (095113.A04)

- 1. Basis of Design Product: Subject to compliance with requirements provide Armstrong World Industries, "Compasso" by USG Interiors, Inc.; Subsidiary of USG Corporation, or comparable product by one of the following:
 - 2. Certainteed World Corporation
 - 3. Armstrong World Industries, Inc.
 - 4. Chicago Metallic Corporation.
 - 5. Fry Reglet Corporation.
 - 6. Gordon, Inc.

- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips and complying with seismic design requirements and the following:
 - 1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 for Alloy and Temper 6063-T5.
 - 2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 3. Color: White as selected by Architect from manufacturer's full range of white options.
 - 4. Depth: 6 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 8. Do not attach hangers to steel deck tabs.
 - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.

10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.
- D. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- E. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. At areas indicated, apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim, unless acceptable to Architect.
- F. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- G. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 3. Hold-Down Clips for Non-Fire-Resistance-Rated Ceilings: For vestibule ceilings adjacent to exterior doors, provide hold-down clips spaced 2'-0" o.c. on all cross-tees for a radius of 10 feet from center of door.
 4. Impact Clips: In all toilet and locker rooms, provide manufacturer's standard impact clip system design to absorb impact forces against lay-in panels.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095433 – DECORATIVE CEILING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following:
 - 1. Decorative panels and suspension systems for ceilings (095433.A01).
- B. Section includes strip suspension systems for interior ceilings and walls, and exterior soffits.
- C. Related Requirements:
 - 1. Section 095113 "Acoustical Ceilings" for lay-in acoustical ceilings with exposed suspension systems.
 - 2. Division 26 for lighting connection for decorative tiles.

1.2 DEFINITIONS

- A. LR: Light Reflectance coefficient.
- B. NRC: Noise Reduction Coefficient.

1.3 COORDINATION

- A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
 - 1. Grille: 12-inch-square module of each type, finish and color.
 - 2. Suspension System Members: 12-inch-long Sample of each type.
 - 3. Exposed Molding and Trim: Set of 12-inch-long Samples of each type, finish, and color.
 - 4. Filler Strips: Set of 12-inch-long Samples of each type, finish, and color.
 - 5. Sound Absorber: 12 inches long.
 - 6. End Cap: Full size.
- D. Delegated-Design Submittal: For design of attachment devices.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and wall elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Grille pattern.
 - 2. Joint pattern.
 - 3. Ceiling suspension members.
 - 4. Method of attaching hangers to building structure.
 - 5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
 - 6. Ceiling perimeter and penetrations through ceiling; trim and moldings.
 - 7. Minimum Drawing Scale: 1/8 inch = 1 foot.
- B. Evaluation Reports: For linear ceiling and components and anchor and fastener type.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Linear Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.9 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and 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.
- B. Source Limitations: Obtain each type of infill panel from single manufacturer and same source.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Class A.
 - 2. Flame-Spread Index: 25 or less.
 - 3. Smoke-Developed Index: 50 or less.
- D. Pre-installation Conference: Conduct conference at Project site.
 - 1. Convene meeting within one week of scheduled start of installation with representatives of the Owner, Construction Manager, Architect, installer, finisher and painter.
 - 2. As applicable, review substrate conditions, requirements for related work, installation instructions, seam finishing, painting instructions, storage and handling, and protection measures.
 - 3. Keep minutes of meeting including responsibilities of various parties.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical ceiling units, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle acoustical ceiling units, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.
 - 1. Store infill planks flat and protected from moisture.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install interior ceilings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use. Building areas to receive ceiling units shall be free of construction dust and debris.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements" to design attachment devices.

- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 450 or less.

2.2 PRE-MANUFACTURED WOOD SUSPENDED GRILLE SYSTEM (095433.A01 – WD3)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide prefinished suspended wood grille with combination backer and dowel, and metal suspension system from Armstrong, as follows:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide USG Ceiling Solutions, “USG True Wood Grilles” with prefinished wood slats, wood dowel and wood backer. Comparable products from other manufacturers meeting specified requirements and design intent will be considered when submitted to and accepted by Architect prior to bidding.
 - a. Fire Resistance: Class “C” rating per ASTM E1264.
 - b. Ceiling Clips: Provide manufacturer’s standard “Direct Load Ceiling Clip (DLCC)” allowing suspension system to be hung directly below an existing suspension system with 15/16-inch face.
 - c. Description:
 - 1) Slats and backers shall be fabricated from FSC Certified solid Poplar hardwood.
 - 2) Dowels shall be fabricated from solid Birch or Poplar.
 - 3) Dimensions:
 - a) Slats shall be 2-1/4 nominal module system consisting of 12 by 96 by 2-3/4 inches, 4 slat configuration with 2-inch spacing. Slats shall be 1-inch wide.
 - b) Wood backers and dowels shall be a custom color as selected by Architect.
 - 4) Accessories:
 - a) Batten Modular.
 - b) 180-degree splice plates.
 - c) 90-degree splice plates.
 - d) Contractor to provide all accessories as required for the installation as indicated on the drawings.
 - 5) Slat/Grille Finish: Custom stain.

2.3 METAL SUSPENSION SYSTEMS

- A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635/C 635M requirements.
- B. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.
- C. Support Components: Coordinate with installation of ceiling grid as indicated in Section 095113 “Acoustical Panel Ceilings”.
- D. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 - 3. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.135-inch-diameter wire.
- F. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- G. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed from 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- H. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and

carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

2.4 ACCESSORIES

- A. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting upward or downward opening.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

2.6 FINISHES

- A. Color-Coated Finish: Manufacturer's standard powder-coat baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear ceilings, and as follows:
 1. Ceilings to receive cladding system shall be dry, flat and rigid.
 2. Vertical alignment (plumbness) of walls shall be within 1/960 (1/8 inch in 10 feet).
 3. Horizontal alignment (levelness) of walls and ceilings shall be within 1/960 (1/8 inch in 10 feet).
 4. Squareness of walls shall be not more than 1/8 inch out of square within the length of the wall.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and on Coordination Drawings.
- B. Condition units by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- C. Lay out planking before installing.
 1. Mark plumb lines on substrate at frame joint locations for accurate installation.
 2. Locate plank frame and trim accessories to allow clearance at plank edges according to manufacturer's written instructions.

3.3 INSTALLATION

- A. Comply with ASTM C 636/C 636M and seismic requirement indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers but without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of linear ceiling area and where necessary to conceal edges and ends of linear pans.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install hold-down clips where indicated.
- G. Ceiling panels shall be erected plumb, level, square, true-to-line, securely anchored and in proper alignment and relationship to work of other trades.
- H. Cut grilles for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- I. Install grilles in coordination with suspension system and exposed moldings and trim.
1. Align joints in adjacent modules/courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
 3. Align grille slats between adjacent sections.
 4. Install end caps.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1. Suspended ceiling system.

2. Hangers, anchors, and fasteners.

B. Ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch.

3.6 CLEANING AND PROTECTION

A. Clean exposed surfaces of decorative ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

1. Protect ceiling installations from damage by other trades after installation as recommended by ceiling system manufacturer.

END OF SECTION 095433

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base (096513.A01).
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturers' standard-size Samples, but not less than 12 inches long.

1.3 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE (096513.A01)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Roppe "Vinyl Wall Base" or comparable products, meeting specified requirements, which are submitted to and accepted by Architect prior to bidding.
- B. Product Standard: ASTM F 1861, Type TV (thermoplastic vinyl).
 - 1. Group: I (solid, homogeneous).
 - a. Cove: RB1, refer to Material Finish Legend for locations.

- C. Product Characteristics:
 - 1. Thickness: 0.125 inch.
 - 2. Height: 4 inches as indicated on drawings.
 - 3. Lengths: Coils in manufacturer's standard length.
 - 4. Outside Corners: Factory fabricated.
 - 5. Inside Corners: Job formed.
 - 6. Colors: Refer to Material Finish Legend for colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.
- C. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes seamless resinous flooring systems (096723.A01 – FT1, FT2) with integral base (096723.A02 – FTB1).

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required; in addition to the following:
 - 1. List each material and cross-reference the specific coating, finish system and application. Identify each material by manufacturer's catalog number and general classification.
- B. Samples for Initial Selection: Where colors and textures are not specifically indicated, submit color and texture samples for Owner's selection.
- C. Samples for Verification: Prior to beginning work, submit samples for each resinous flooring system color, texture and sheen required and as follows:
 - 1. Samples shall be 6 inches square, applied to a rigid backing by Installer for this Project.
 - 2. Resubmit samples as requested until required sheen, color and texture is acceptable to Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Submit certificates signed by resinous flooring manufacturer certifying that installer complies with specified requirements, in addition to the following:
 - 1. Submit substantiating evidence experience installing the specific brand of products proposed in similar areas, in addition to meeting Installer Qualification criteria.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an Installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated. Installer shall be/have been trained by flooring system manufacturer with experience in application and installation of systems similar in complexity to those required for this project, in addition to the following:
 - 1. Installer shall have a minimum of three (3) years continuous experience under the current company name.
 - 2. Installer shall submit a reference list of at least seven (7) projects, similar in size and applied system(s), completed in the states of Missouri and Kansas. Include contact information for Construction Manager, as applicable, and Owner. List types and names of systems installed, each material/component of system(s) installed, quantity installed and dates completed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components. Include handling instructions and precautions.
- B. Store materials not in actual use in tightly covered containers at a minimum ambient temperature of 45 deg F in a well-ventilated area. Maintain containers in clean condition, free from foreign material and residue.

1. Protect liquid components from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary precautionary measures to ensure workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of floor systems.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
 1. Do not commence work until the building can be maintained at a temperature range between 60 deg F and 90 deg F for 48 hours before, during and 48 hours after application. Broom clean areas (reasonably dust free) and have adequate controlled ventilation.
 2. Maintain ventilation in each area indicated to receive resinous flooring until completion of the resinous flooring work in that area.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.
- D. Surfaces to receive resinous flooring must be acceptable and in accordance with flooring system manufacturer's recommendations.
 1. Notify Architect in writing of unsuitable surfaces and conditions. Commencement of work implies acceptance of surfaces and working conditions.

1.9 PROTECTION

- A. Protect adjacent surfaces from damage resulting from work of this trade. If necessary, mask and/or cover adjacent surfaces, fixtures, cabinetry, equipment, etc. by suitable means.
- B. Post "NO SMOKING" signs while work is in progress and during curing.

1.10 SPECIAL WARRANTY

- A. Contractor, manufacturer and installer have responsibility for an extended corrective period for work of this Section for a period of three (3) years from date of Substantial Completion against all conditions indicated below, and when notified in writing by Owner, Contractor/manufacturer/installer shall promptly and without inconvenience and cost to the Owner, correct said deficiencies in compliance with the requirements of the Conditions of the Contract.
 1. Flooring system manufacturer and Installer shall co-sign warranty and shall be responsible for:
 - a. Bond failure of system(s) to substrate.
 - b. System yellowing, including regionalized discoloration.
 - c. Excessive wear.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Flammability: Self-extinguishing according to ASTM D 635.

- C. Slip Resistance: Resinous flooring surfaces shall have the following minimum performance requirements as indicated below.
 - 1. Static Dry Coefficient of Friction: 0.6 minimum per ASTM D2047.
 - 2. Dynamic Wet Coefficient of Friction: 0.45 minimum per ANSI A326.3 or ANSI B101.3.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, body coats, and topcoats, from single source from single manufacturer to ensure material compatibility, chemical and mechanical bond; quality of materials, color and pattern consistency. Obtain secondary materials, including patching and fill material, color chips/flakes and granules, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING (096723.A01 – FT1, FTB1)

- A. Basis-of-Design Product: Subject to compliance with specified requirements, provide Dur-A-Flex; “Poly-Crete MDB” with a two-part urethane resinous flooring system or comparable product from one of the resinous flooring systems listed below.
 - 1. Comparable products from manufacturers listed below and other manufacturers which meet or exceed specified requirements will also be considered when submitted to and accepted by Architect as a substitution prior to bidding only.
 - a. Desco.
 - b. Tennant.
 - c. Tnemec.
 - d. Stonhard.
 - e. Comparable products from other manufacturers which meet or exceed specified requirements will also be considered when submitted to and accepted by Architect as a substitution prior to bidding only.
- B. Resinous Flooring System: System shall be self-leveling broadcast quartz, abrasion-, UV-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- C. System Characteristics:
 - 1. Color and Pattern: As indicated in the Material Finish Legend on the drawings.
 - 2. Topping: Dur-A-Flex, Inc. Poly-Crete MD resin, hardener and aggregate.
 - 3. Aggregate: Dur-A-Flex, Inc. Flintshot quartz aggregate.
 - 4. Topcoat: Dur-A-Flex, Inc. Poly-Crete Color-Fast resin, hardener and powder aggregate.
 - 5. Overall System Thickness: Not less than 1/4 inch, excluding primer thickness.
- D. Primer: Provide manufacturer’s recommended primer to suit substrate and resinous flooring system indicated.
- E. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks and control joints from reflecting through resinous flooring.
 - a. Provide fiberglass scrim embedded in reinforcing membrane.
- F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- G. Body Coats-Topping: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - 1. Resin: Epoxy.
 - 2. VOC: 0 g/L.
 - 3. Percent Reactive: 100 percent.
 - 4. Bond Strength to Concrete ASTM D 4541: 400 psi, substrate fails.
 - 5. Compressive strength, ASTM C 579: 7,400 psi.
 - 6. Tensile Strength, ASTM D 638: 1,800 psi.
 - 7. Impact Resistance @125 mils, MIL D-3134, no-visible damage or deterioration: >160 inch lbs.

- H. Topcoats: Sealing or finish coats.
 - 1. Resin: Cementitious Urethane.
 - 2. Formulation Description: 100 percent solids.
 - 3. VOC: 0 g/L.
 - 4. Compressive Strength, ASTM C 579: 7,800 psi.
 - 5. Tensile Strength, ASTM D 638: 4,200 psi.
 - 6. Flexural Strength, ASTM D 790: 1,000 psi.
 - 7. Abrasion Resistance, ASTM D 4060 CS-17-wheel, 1,000 gm load, 1,000 cycles: 30mg loss.
 - 8. Impact Resistance, ASTM D 1709: 160 in. lbs.
 - 9. Shore D Hardness, ASTM D 2240: 65.
 - 10. Gloss, ASTM D 523, 60 degrees: Semi-gloss appearance.
 - 11. Number of Coats: As required to achieve overall system thickness specified and texture selected.
 - 12. Finish Texture and Sheen: Semi-gloss sheen to match sample approved by Architect.

- I. Integral Cove Base (096723.A02): Provide integral coved base of height indicated with 1 inch radiused cove and bullnosed top edge termination.

- J. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion in the following reagents for no fewer than seven days:
 - 1. Bleach (3%).
 - 2. Coffee.
 - 3. Hydro peroxide (3%).
 - 4. Nitric acid (10%).
 - 5. Phosphoric acid (20%).
 - 6. Sodium hydrate (40%).
 - 7. Urine.

2.4 RESINOUS FLOORING (096723.A01 – FT2)

- A. Basis-of-Design Product: Subject to compliance with specified requirements, provide Dur-A-Flex; “DUR-A-CHIP” resinous flooring system or one of the resinous flooring systems listed below.
 - 1. DESCO Coatings, Inc.; “Granite Series” with aliphatic urethane topcoat.
 - 2. Tennant; “ECO-DFS” with aliphatic urethane topcoat.
 - 3. Tnemec; Series 224 “DECO-Fleck” with aliphatic urethane topcoat.
 - 4. Comparable products from other manufacturers which meet or exceed specified requirements will also be considered when submitted to and accepted by Architect as a substitution prior to bidding only.

- B. Resinous Flooring System: Abrasion-, impact-, UV-, and chemical-resistant, flake-aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor.

- C. System Characteristics:
 - 1. Color and Pattern: As indicated by mix designs on Drawings.
 - 2. Wearing Surface: Orange-peel texture to match approved sample.
 - 3. Overall System Thickness: Not less than 1/16-inch (62.5 mils), excluding primer thickness.

- D. Primer: Provide manufacturer’s recommended primer to suit substrate and resinous flooring system indicated.
 - 1. Formulation Description: 100 percent solids.

- E. Body and Grout Coats:
 - 1. Resin: Epoxy.
 - 2. Formulation Description: 100 percent solids.
 - 3. Type: Grey.
 - 4. Application Method: Self-leveling slurry with broadcast aggregates. Aggregates shall be broadcast to rejection.
 - 5. Number of Coats: As required to achieve overall system thickness specified.
 - 6. Aggregates: Manufacturer’s standard vinyl flakes.
 - a. Flake aggregates shall be available in at least two sizes. Refer to mix design for colors and sizes.
 - b. There will be one base color aggregate and up to five accent colors selected by the Architect.

- F. Topcoats: Sealing or finish coats.
 - 1. Resin: Aliphatic urethane.
 - 2. Formulation Description: High solids.
 - 3. Type: Clear.
 - 4. Number of Coats: As required to achieve overall system thickness specified.
 - 5. Thickness of Coats: Not less than 6 mils.
 - 6. Finish: Matte/satin.

- G. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
 - 1. Compressive Strength: 10,000 psi minimum according to ASTM C 579.
 - 2. Compressive Strength: 16,000 psi minimum according to ASTM D 695.
 - 3. Tensile Strength: 1,600 psi minimum according to ASTM C 307.
 - 4. Flexural Modulus of Elasticity: 3,900 minimum according to ASTM C 580.
 - 5. Water Absorption: 0.04 percent maximum according to ASTM C 413 or ASTM D 570.
 - 6. Bond Strength (to concrete): 400 psi minimum according to ASTM D 2240, substrate fails.
 - 7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation according to MIL-D-3134J.
 - 8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch according to MIL-D-3134J.
 - 9. Abrasion Resistance: 0.24 mg maximum weight loss according to ASTM C 501.
 - 10. Hardness: 75 - 80, Shore D according to ASTM D 2240.
 - 11. Flammability: Self extinguishing according to ASTM D 635.
 - 12. Flame Spread/NFPA-101: Class A according to ASTM E 84.

- H. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion in the following reagents for no fewer than seven days:
 - 1. Hydrochloric Acid (20%).
 - 2. Urine.
 - 3. Coffee.
 - 4. Ethyl Alcohol.
 - 5. Iodine.
 - 6. Lactic Acid (10%).
 - 7. Tea.
 - 8. Mustard.
 - 9. Mercurochrome.
 - 10. Betadyne.

2.5 ACCESSORIES

- A. Metal Strips: Profile as specified below, height to match resinous flooring thickness, metallic base, designed specifically for flooring and wall applications; white zinc alloy or stainless-steel, ASTM A 666, 300 Series exposed-edge material. Provide the following metal strips:
 - 1. Basis-of-Design: Provide Schluter; "SCHIENE, E-30" with stainless steel legs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Contractor shall examine subfloor surfaces to verify all substrates and conditions are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, ridges, curing compounds, and other adhesives and coatings that may inhibit bonding capability of resinous flooring and primer, as well as other defects that may impair performance and appearance.
 - 1. A satisfactory subfloor surface is further defined as one that meets the alkalinity and moisture vapor emissions criteria set forth hereinafter.

3.2 PREPARATION

- A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
 - 1. Areas where flooring is existing, must be cleaned to remove all floor material, adhesives, grease or any residue that may interfere with interfacial adhesion between substrate and new resinous flooring system.

2. Prepare concrete substrates by shot blasting or grinding to achieve surface profile recommended by resinous flooring manufacturer.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, adhesives, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 3. Moisture Testing: Perform moisture testing as Contractor deems necessary and as required by resinous flooring manufacturer.
 - a. General: Contractor, as he deems necessary, may perform the moisture testing below at his own expense. See section 033000 "Cast-in-Place Concrete" for moisture mitigating primer admixture provided in concrete slabs to receive resilient sheet flooring.
 - b. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
 - c. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
 - d. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.3 APPLICATION

- A. Proceed with resinous flooring work after subfloor surfaces are satisfactory. Commencement of resinous flooring work is construed as Installer's acceptance of substrate surfaces within a particular area.
- B. Apply components of resinous flooring system according to manufacturer's **latest** written instructions, employing technically-trained, approved mechanics, to produce a uniform, monolithic and seamless wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Coordinate locations for metal edging and install metal edging according to edging manufacturer's recommendations.
 3. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 4. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
 - a. Do not fill moving isolation joints or expansion joints.
 - b. At movement joints, provide membrane isolation strips and reinforcing tape as recommended by resinous flooring manufacturer.
- C. Moisture Mitigating Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate to prevent moisture migration through substrate involved.

- D. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks.
 - 1. Fill non-moving control joints with approved elastomeric sealant or full-depth semi-rigid two-component epoxy joint filler, designed specifically for this purpose (use full-depth semi-rigid joint filler when reinforcement of the joint edge is desirable), or two-component epoxy and filler (epoxy to be same material as flooring).
- E. Integral Cove Base: Apply integral cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 - 1. Integral Cove Base: Height as indicated on Material Finish Legend.
 - 2. Hand-sand cove base and 4 inches onto field of floor.
 - 3. Apply three topcoats to assure smooth surface of the cove base.
- F. Body Coats: Apply body coats using method recommended by manufacturer and in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.
- G. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.
- H. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.
- I. Cure resinous flooring in compliance with flooring manufacturer's directions to prevent contamination during all stages of application.
- J. Finish work shall match approved samples; be uniform in thickness, sheen, color and texture; and be free of defects detrimental to appearance and performance.

3.4 FIELD QUALITY CONTROL

- A. Material Sampling: Architect and Owner's Representative may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.
 - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.
- B. Core Sampling: At the direction of Owner's Representative and at locations designated by Architect, take one core sample per 1000 sq. ft. of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

3.5 CLEANING AND PROTECTION

- A. Clean resinous flooring prior to Substantial Completion. Use materials and procedures recommended by resinous flooring manufacturer.
- B. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.
 - 1. Remove any temporary covering prior to cleaning and final inspection.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular carpet tile (096813.A01).
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.2 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Pattern of installation.
 - 3. Pattern type, location, and direction.
 - 4. Carpet tile type, color, and dye lot.
 - 5. Type, color and location of insets and borders.
 - 6. Type, color and location of edge, transition, and other accessory strips.
 - 7. Transition details to other flooring materials.
- A. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
- B. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Furnish one un-opened box of each carpet tile type, color and pattern for every 5 percent of amount installed.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- C. Mockups/Field Samples: Build mockups/field samples to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups/field samples for carpet tile including accessories.
 - a. Size: Minimum 50 sq. ft. for each type, color, and pattern in locations directed by Architect.
 - 2. Approval of mockups/field samples does not constitute approval of deviations from the Contract Documents contained in mockups/field samples unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.9 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (096813.A01 – C1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products specified on drawings or a comparable products meeting specified requirements, having similar colors and patterns as acceptable to Architect with the following characteristics submitted to and accepted by Architect prior to bidding.
 - 1. Refer to Material Finish Legend for carpet selections including name, manufacturer, and installation pattern.

- B. Carpet Type C1: Subject to compliance with requirements, provide "Steppin Out" by Shaw Contract.
 - 1. Product Construction: Needlebond Diagonal.
 - 2. Fiber Type: PET polyester.
 - 3. Dye Method: 100% Solution dyed.
 - 4. Machine Gauge: 1/12 inch.
 - 5. Stiches: 11 /in
 - 6. Pile Density: 6,091 oz/yd
 - 7. Tufted Yarn Weight: 44.5 oz/yd².
 - 8. Thickness: 0.348 inch.
 - 9. Radiant Panel: ASTM E-648 Class 1.
 - 10. Smoke Density: ASTM E-662 ≤ 450.
 - 11. Backing: Synthetic, Ecoworx Tile.
 - 12. Size: 24 inches x 24 inches.
 - 13. Color and Pattern: As indicated on Material Finish Legend.
 - 14. Installation Method: As indicated on Material Finish Legend.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
 - 1. Basis-of-Design Product: C1 provide manufactures recommendation for adhesive for project requirements.

- C. Topical Concrete Vapor Sealer: Liquid penetrating type or film-forming type, designed to seal concrete and inhibit moisture transmission through slab. Concrete vapor sealers shall be as recommended by tile carpeting Contractor based upon successful previous installations and as acceptable to tile carpeting manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider

and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by carpet tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by carpet tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Contractor, as he deems necessary, may conduct moisture testing of slabs:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours, unless a higher rate is accepted by flooring manufacturer in writing.
 - 1) Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.
 - b. Perform relative humidity test using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 80 percent relative humidity level measurement, unless a higher rate is acceptable to flooring manufacturer.
- E. Concrete Vapor Sealer Application: Concrete vapor sealer is required. Prepare surfaces to receive concrete vapor sealer and apply concrete vapor sealer in strict accordance with vapor sealer manufacturer's written instructions to suit slab moisture conditions encountered. Concrete vapor sealers shall be acceptable to tile carpeting manufacturer.
 - 1. Sealer shall accommodate 95% RH.
- F. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method:
 - 1. At perimeter of each room/area: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
 - 2. In field of room/area (inside glued down perimeter): install tiles with factory-applied releasable, pressure-sensitive adhesive strips.
- C. Installation Layout: As indicated on Material Finish Legend.
- D. Maintain dye lot integrity. Do not mix dye lots in same area.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, non-staining marking device.
- H. Install pattern parallel to walls and borders.

- I. Metal Transition Strips: Install at locations indicated and between carpet tile and adjacent finishes. Installation shall be in strict accordance with edging manufacturer's written recommendations.
- J. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- K. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- L. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.
- M. Transitions are not required between resilient tile flooring and tile carpeting.

END OF SECTION 096813

SECTION 098436 - SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes shop-fabricated, pre-finished panel units tested for acoustical performance, including:
 - 1. Cementitious sound-absorbing ceiling units (098436.A01 – AP1)

1.2 DEFINITIONS

- A. NRC: Noise reduction coefficient.
- B. SAA: Sound absorption average.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, mounting, material descriptions, dimensions of individual components and profiles, and finishes for sound-absorbing ceiling units.
 - 2. Include furnished specialties and accessories.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
 - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.
- C. Samples for Verification: For the following products:
 - 1. Mounting Devices: Full-size Samples.
 - 2. Assembled Panels: Approximately 36 by 36 inches (900 by 900 mm), including joints and mounting methods.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.
 - 1. Electrical outlets.
 - 2. Suspended ceiling components above ceiling units.
 - 3. Structural members to which suspension devices will be attached.
 - 4. Items penetrating or covered by units including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Alarms.
 - e. Sprinklers.
 - f. Access panels.
- B. Product certificates: For each type of sound-absorbing ceiling unit.
- C. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.

1. Build mockup of typical ceiling area 96 inches (2400 mm) wide by full width of ceiling. Include intersection of wall and ceiling, corners, and perimeters.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound-absorbing and sound diffusing ceiling units to include in maintenance manuals.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with sound-absorbing ceiling unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of sound-absorbing ceiling units and actual dimensions of openings and penetrations by field measurements before fabrication.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sound-absorbing ceiling units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Acoustical performance.
 - b. Warping of core.
 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide sound-absorbing ceiling units meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.

2.2 CEMENTITIOUS SOUND-ABSORBING CEILING UNITS

- A. Sound-Absorbing Ceiling Panel (098436.A01 – AP2): Cementitious-fiber cement mechanically attached panels.
 1. Mounting: Mechanically attached "A-Mounting" per Tectum.
 2. Total Panel Thickness: 2-1/2 inches.
 3. Edge Profile: Long edge beveled and short edge square.
 4. Acoustical Performance: Sound absorption NRC of not less than 0.85 according to ASTM C423 for use with A mounting.
 5. Panel Width: As indicated on Drawings.
 6. Panel Length: As indicated on Drawings.
 7. Facing: Cementitious-fiber cement
 8. Facing Thickness: 1 inch
 9. Furring: Cementitious-fiber cement strips
 10. Furring Thickness: 1 inch.
 11. Core: Mineral fiber.
 12. Core Thickness: 1 inch.

13. Finish: Factory primed (white).
14. Surface Texture: Coarse.
15. Composition: Aspen wood fibers bonded with inorganic hydraulic cement.
16. Color: As selected by Architect from manufacturer's full line of colors.
17. Flame Spread: ASTM E 1264 Class A.
18. Treatment: HumiGuard Plus.
19. Basis of Design: "Tectum® Shapes and Clouds™" by Armstrong World Industries, Inc.
 - a. Comparable products from other manufacturers meeting specified requirements which are submitted to and accepted by Architect prior to bidding will be considered.

2.3 MATERIALS

- A. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit.
- B. Fasteners: Provide stainless steel fasteners designed for mechanical attachment to concrete substrates, similar to "410 Stainless Steel Series" by Tapcon.

2.4 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated; with dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
 1. Thickness.
 2. Edge straightness.
 3. Overall length and width.
 4. Squareness from corner to corner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing ceiling units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with sound-absorbing ceiling unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
 1. Installation Type: A

3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch.
- B. Variation from Level or Slope: Plus or minus 1/16 inch.
- C. Variation of Panel Joints from Hairline: Not more than 1/16 inch wide.

3.4 CLEANING

- A. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098436

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel.
 - 2. Steel doors and frames.
 - 3. Aluminum.
- B. Related Requirements:
 - 1. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
 - 2. Section 099600 "High Performance Coatings" for special-use coatings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: Where colors are not indicated on Drawings, submit for each type of topcoat product.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 6 inches square.
 - 2. Label each coat of each Sample.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. VOC content.

1.3 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. Paint: Two (2) gallons of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers - Basis of Design Products: Subject to compliance with requirements, provide products The Sherwin-Williams Company, or comparable products from another manufacturers submitted to and accepted by Architect and Owner prior to bidding.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: Where not indicated on Drawings, as selected by Architect from manufacturer's full range.
- C. Paint Systems: Refer to schedule at end of this Section.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and re-prime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - a. Do not paint pre-finished and anodized aluminum surfaces.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Steel Substrates - Primed:
 - 1. The Sherwin-Williams Company.
 - a. 1 touchup coat Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Pro Industrial WB Alkyd Urethane, low sheen.

- B. Steel Substrates – Galvanized (except railings, handrails and guardrails):
 - 1. The Sherwin-Williams Company.
 - a. 1 touchup coat Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - 2 coats Pro Industrial WB Alkyd Urethane, low sheen.

- C. Primed Steel Doors and Frames:
 - 1. The Sherwin-Williams Company.
 - a. 1 touchup coat of Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Pro Industrial WB Alkyd Urethane, low sheen.

- D. Aluminum Substrates:
 - 1. The Sherwin-Williams Company.
 - a. 2 coats A-100 Latex, satin.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of opaque paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Steel.
 - 3. Galvanized metal.
 - 4. Aluminum (not anodized or otherwise coated).
 - 5. Gypsum board.

- B. Related Requirements:
 - 1. Section 012100 "Allowances" for those allowances affecting work of this Section.
 - 2. Section 012200 "Unit Prices" for unit prices affecting work of this Section.
 - 3. Section 012300 "Alternates" for those alternates related to work of this Section.
 - 4. Section 051200 "Structural Steel Framing" for shop priming structural steel.
 - 5. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
 - 6. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
 - 7. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.
 - 8. Section 099600 "High-Performance Coatings" for special-use coatings.

1.2 DEFINITIONS

- A. Gloss Level 1 "Matte": Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2 "Flat": Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3 "Eggshell": 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4 "Satin-like": 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5 "Semi-gloss": 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6 "Gloss": 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7 "High Gloss": More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 6 inches square.
 - 2. Label each coat of each Sample.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas.
 - 2. Use same designations indicated on Drawings and in schedules.
 - 3. Include color designations.
 - 4. VOC content.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: One (1) gallon of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups/Field Samples: Apply mockups/field samples of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups/field samples.
 - a. If preliminary color selections are not approved, apply additional field samples of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers - Basis of Design Products: Subject to compliance with requirements, provide products The Sherwin-Williams Company, or comparable products from another manufacturers submitted to and accepted by Architect and Owner prior to bidding.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: Where not indicated on Drawings, as selected by Architect from manufacturer's full range, matching Sherwin Williams, Benjamin Moore & Co.
 - 1. 20 percent of surface area will be painted with deep tones.

- C. Material Finish Schedule designations: As indicated on Material Finish Legend.
 1. Provide "flat" sheen for ceilings and soffits, unless otherwise specified.
 2. Provide "eggshell" sheen for walls, unless otherwise specified.
 3. Flat: (099123.A01), ceiling finishes.
 4. Eggshell: (099123.A02), wall finishes.
 5. Semi-Gloss (099123.A04).
 6. Gloss (099123.A05).
 7. Dryfall: (099123.A07).
- D. Paint Systems: Refer to schedule at end of this Section.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Gypsum Board: 12 percent.
 2. Masonry (Clay and CMUs): 12 percent.
 3. Wood: 15 percent.
- C. Gypsum Board Substrates: Verify that finishing compound and gypsum veneer plaster is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Aluminum Substrates: Remove loose surface oxidation.
- I. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
 - 6. Paint exposed air diffusers and grilles same color as adjacent wall finish.
 - 7. Mask off surfaces of doors prior to painting vision lite frames. Clean any excess paint from door surface to so that there is no evidence of excess paint remaining on door face and glass.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Other items as directed by Architect.
 - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

- F. Marking and Identification: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other walls required to have protected openings and penetrations shall be permanently identified with stenciling. Such identification shall:
 - 1. Be located in accessible concealed floor, floor/ceiling or attic spaces;
 - 2. Be located within 15 feet of the end of each wall and at intervals not exceeding 30 feet measured horizontally along the wall or partition; and
 - 3. Shall include lettering not less than 3 inches in height with a minimum 3/8-inch wide stroke in a contrasting color incorporating the following wording on the first line: "FIRE AND/OR SMOKE BARRIER – PROTECT ALL OPENINGS".

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates – Non-primed:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat of Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Pro Industrial WB Alkyd Urethane. (semi-gloss)
- B. Steel Substrates – Pre-primed:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat of Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Pro Industrial WB Alkyd Urethane. (semi-gloss)
- C. Steel Hollow Metal Doors and Frames (including doors, frames, metal glass stops, vision lite frames, astragals and metal louvers):
 - 1. The Sherwin-Williams Company.
 - a. 1 coat of Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Pro Industrial WB Alkyd Urethane. (semi-gloss)
- D. Steel Substrates (exposed metal decking, bar joists and exposed over-head structure) – Dryfall.
 - 1. The Sherwin-Williams Company.
 - a. 2 coats Waterborne Acrylic Dryfall, eggshell.
- E. Galvanized-Metal Substrates (where not specifically indicated to be painted):
 - 1. The Sherwin-Williams Company.
 - a. 1 coat of Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Pro Industrial Acrylic. (semi-gloss)

- F. Galvanized-Metal Ductwork Substrates:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat of Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Waterborne Acrylic Dryfall, eggshell.

- G. Aluminum (Not Anodized or Otherwise Coated) Substrates:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat of Pro Industrial Pro-Cryl Universal WB Acrylic Primer.
 - b. 2 coats Pro Industrial WB Alkyd Urethane.

- H. Gypsum Board Wall and Ceiling Substrates indicated to receive Vinyl Wall Graphics – prepare per the wallcovering manufacturer’s printed recommendations.
 - 1. The Sherwin-Williams Company.
 - a. 1 coat ProMar 200 Zero VOC Interior Latex Primer.

- I. Gypsum Board Wall and Ceiling Substrates indicated to receive Wall Covering – prepare per the wallcovering manufacturer’s printed recommendations.
 - 1. The Sherwin-Williams Company.
 - a. 1 coat ProMar 200 Zero VOC Interior Latex Primer.

- J. Gypsum Board Wall Substrates – Latex:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat ProMar 200 Zero VOC Interior Latex Primer.
 - b. 2 coats ProMar 200 Zero VOC Latex, eggshell.

- K. Gypsum Board Ceiling Substrates – Latex:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat ProMar 200 Zero VOC Interior Latex Primer.
 - b. 2 coats ProMar 200 Zero VOC Latex, flat.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of transparent finishes on the following substrates:
 - 1. Interior Substrates:
 - a. Dressed lumber (finish carpentry or woodwork).
- B. Related Requirements:
 - 1. Section 081416 "Flush Wood Doors" for stains and transparent finishes on doors.

1.2 DEFINITIONS

- A. Gloss Level 3 "Eggshell": 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 4 "Satin-like": 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 5 "Semi-gloss": 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. Gloss Level 6 "Gloss": 70 to 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Initial Selection: Where colors are not specifically indicated, submit for each type of product.
- C. Samples for Verification: For each type of finish system and in each color and gloss of finish required.
 - 1. Submit Samples on representative samples of actual wood substrates, 8 inches square.
 - a. Apply finish to half of sample.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas.
 - 2. Use same designations indicated on Drawings and in schedules.
 - 3. Include color designations.
 - 4. VOC content.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Stains and Transparent Finishes: 1 gallon of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures less than 5 deg F above the dew point, or to damp or wet surfaces.
- C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products from "The Sherwin-Williams Company" or comparable products from one of the manufacturers listed below. Comparable products shall be submitted with a cross reference list which includes product data, application information and performance criteria for the Basis-of-Design Products scheduled as well as the proposed comparable products so that a direct comparisons may be made.
 1. Benjamin Moore & Co.
 2. Glidden Professional.
 3. PPG Paints.
- B. Products: Subject to compliance with requirements, provide one of the products listed in wood finish systems schedules for the product category indicated.

2.2 MATERIALS, GENERAL

- A. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
 3. To the best extent possible, provide products from a single manufacturer.
- B. Paint Systems: Refer to schedule at end of this Section.

2.3 WOOD FILLERS

- A. Wood Filler Paste: MPI #91, as recommended by topcoat manufacturer.

2.4 POLYURETHANE VARNISHES

- A. Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4):
 1. The Sherwin-Williams Company.
 - a. 2 coats Wood Classics Polyurethane Varnish.

- B. Varnish, Interior, Polyurethane, Waterborne, Satin (Gloss Level 4):
 - 1. The Sherwin-Williams Company.
 - a. 2 coats Wood Classics Waterborne Polyurethane Varnish.

2.5 SOURCE QUALITY CONTROL

- A. Testing of Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- D. Interior Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
 - 3. Sand surfaces exposed to view and dust off.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

- A. Apply finishes according to coating manufacturer's written instructions and recommendations.
 - 1. Use applicators and techniques suited for finish and substrate indicated.
 - 2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
 - 3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

- A. Wood substrates, non-traffic vertical surfaces:
 - 1. 1 coat stain.
 - 2. 2 coats polyurethane varnish.
- B. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4):
 - 1. WoodClassics Polyurethane Varnish.
- C. Varnish, Interior, Polyurethane, Waterborne, Satin (Gloss Level 4):
 - 1. WoodClassics Waterborne Polyurethane Varnish.

END OF SECTION 099300

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems (099600.A01) on the following substrates:
 - 1. Exterior Substrates:
 - a. Steel.
 - 2. Interior Substrates:
 - a. Concrete, vertical and horizontal surfaces.
 - b. Cement board.
 - c. Steel.
 - d. Galvanized metal.
 - e. Aluminum (not anodized or otherwise coated).
 - f. Wood.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming of structural steel with primers specified in this Section.
 - 2. Section 099123 "Interior Painting" for general field painting.

1.2 DEFINITIONS

- A. Gloss Level 3 "Eggshell": 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 5 "Semi-gloss": 35 to 70 units at 60 degrees, according to ASTM D 523.
- C. Gloss Level 6 "Gloss": 70 to 85 units at 60 degrees, according to ASTM D 523.
- D. Gloss Level 7 "High Gloss": More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to coating system and locations of application areas.
 - 2. Use same designations indicated on Drawings and in schedules.
 - 3. Color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Coatings: One (1) gallon of each material and color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide products of The Sherwin-Williams Company as set forth hereinafter or comparable products, acceptable to Owner, by one of the following:
 1. Benjamin Moore & Co.
 2. Glidden Professional.
 3. PPG Paints.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
 3. Products shall be of same manufacturer for each coat in a coating system.
- B. Colors: Where not indicated on Material Finish Legend, as selected by Architect from manufacturer's full range.
- C. Paint Systems: Refer to schedule at end of this Section.
- D. Material Finish Legend designations: "EP."

- E. Sheens:
 - 1. Provide “eggshell” sheen (099600.A01) for walls, unless otherwise specified.
 - 2. Semi-gloss finish (099600.A02) for steel.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
 - 1. Owner may engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 - 2. Testing agency will perform tests for compliance with product requirements.
 - 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer’s written instructions applicable to substrates and paint systems indicated.
 - 1. Prepare previously primed and previously painted surfaces indicated to receive new paint finish in strict accordance with paint manufacturer’s written recommendations.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. Painted Steel Substrates: Clean and prepare as recommended by coating manufacturer.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Structural and Miscellaneous Steel:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat Macropoxy 646, 5 to 8 mils DFT.
 - b. 2 coats Acrolon 218 HS Polyester Acrylic Polyurethane, semi-gloss.
- B. Steel Substrates:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat Macropoxy 646.

- b. 1 coat FluoroKem HS.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Exposed Structural Steel Columns, Framing and Stairs:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat Macropoxy 646.
 - b. 1 coat Acrolon 218 HS Polyester Acrylic Polyurethane, semi-gloss.
- B. Concrete Substrates - Epoxy System (non-wet walls):
 - 1. The Sherwin-Williams Company.
 - a. 1 coat Loxon Block Surfacer, 18 mils wet, 8 mils dry.
 - b. 2 coats Pro Industrial Pre-Catalyzed Water Based Epoxy, single-component, eggshell.
- C. Concrete - Epoxy System (wet areas):
 - 1. The Sherwin-Williams Company.
 - a. 1 coat KemCati Kote High Solids Epoxy Filler/Sealer.
 - b. 2 coats Pro Industrial Zero VOC Waterborne Catalyzed Epoxy, two-component, eggshell.
- D. Gypsum Board Wall Substrates – Epoxy:
 - 1. The Sherwin-Williams Company.
 - a. 1 coat ProMar 200 Zero VOC Interior Primer.
 - b. 2 coats Pro Industrial Pre-Catalyzed Water Based Epoxy, single-component, eggshell.
- E. Gypsum Board Wall Substrates – Epoxy (wet areas):
 - 1. The Sherwin-Williams Company.
 - a. 1 coat ProMar 200 Zero VOC Interior Primer.
 - b. 2 coats Pro Industrial Zero VOC Waterborne Catalyzed Epoxy, two-component, eggshell.
- F. Gypsum Board Ceiling Substrates – Epoxy (wet areas):
 - 1. The Sherwin-Williams Company.
 - a. 1 coat Sherwin Williams Macropoxy 646.
 - b. 2 coats Pro Industrial Zero VOC Waterborne Catalyzed Epoxy, two-component, eggshell.

END OF SECTION 099600

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior:
 - a. Fabricated:
 - 1) Illuminated – Halo Lit (101400.A11).
 - 2. Exterior Signage:
 - a. Fabricated:
 - 1) Illuminated – Halo Lit (101400.A102).
- B. Related Sections include the following:
 - 1. Section 012100 "Allowances" for interior room signage and exterior door signage.
 - 2. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
 - 3. Section 101423 "ADA and Code Signage" for related graphics and signage.
 - 4. Division 26 Section "Interior Lighting" and "Exterior Lighting" for illuminated signs.

1.2 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."
- B. Signage Contractor: Contractor responsible for the fabrication and installation of signage unless responsibility for fabrication or installation is called out by others in the drawings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Including but not limited to, the following:
 - 1. Manufacturer's technical product data for each type of product specified. Include data on physical characteristics, durability, fade resistance, flame resistance and manufacturing process.
 - 2. Product data shall show compliance with requirements for fire performance characteristics and physical properties.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
 - 3. Include fabrication and installation details, and attachments to other work.
 - 4. Include elevations, component details, and attachments to other work for dimensional letter signage.
 - 5. Indicate materials and profiles of signage fittings, joinery, finishes, fasteners, anchorages, and accessory items.
 - 6. Wiring Diagrams for illuminated signage.
 - 7. Field Dimensions shall be obtained, reviewed, and accepted by signage manufacturer prior to submittal of shop drawings.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
 - 1. Aluminum.
- D. Samples for Verification:
 - 1. Submit 12-inch-long actual samples of each accessory required.
 - 2. Sample from same flitch to be used for the Work, with specified finish applied.

- E. Delegated-Design Submittal: For exterior signage, including signage.
 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Include design of concrete base, concrete footing, and anchorage to signage frame.
- F. Sign Schedule: Use same designations indicated on Drawings.
- G. Mockups/Field Samples: Build mockups/field samples to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 2. Subject to compliance with requirements, approved mockups/field sample areas may become part of the completed work if undisturbed at the time of Substantial Completion.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals. Include the following:
 1. Methods for maintaining wall covering.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Fabricator Qualifications: A firm that employs skilled workers experienced in producing custom-fabricated products similar to those required for this Project and with at least seven years continuous experience under the current company name. Fabricator shall have a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 1. Fabricator shall have completed at least seven (7) similar signage projects having similar requirements within the last four (4) years for each signage type.
- C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines.
- E. Fire Performance Characteristics: Provide wall coverings with the following surface burning characteristics as determined by testing identical products per ASTM E 84 by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify wall coverings with appropriate markings of applicable testing and inspecting organization.
 1. Flame Spread: 5 or less.
 2. Smoke Developed: 25 or less.

F. ADA Accessibility Guidelines: Signage shall comply with the ADA Accessibility Guidelines where applicable. Characters and graphics, including but-not limited to, copy height, letter stroke symbols, materials, and finishes indicated on the Drawings are intended as guidelines for compliance. Implement each applicable ADA guideline. Should conflicts arise, notify the Designer before proceeding.

1.7 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 1. Required parties include the contractor, sub-contractor and architect/designer.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review temporary protection requirements for during and after installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations for Exterior Signage: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage to signage. Store materials to permit easy access for inspection and identification.
 - 1. Keep aluminum off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect aluminum and packaged materials from corrosion and deterioration.
- B. Store signage in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.10 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.
 - 1. For dimensional letters, furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of exterior signage type(s) to withstand design loads as indicated on Drawings.
- B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- C. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.
- 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 MATERIALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
 - 1. Plate and Sheet: ASTM B 209, Alloy 3003-H14, Alloy 5005-H32 or Alloy 6061-T6.
 - 2. Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
 - 3. Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.3 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Acrylic Sheet Finishes
 - 1. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.
- E. Aluminum Finishes
 - 1. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.
 - 2. Powder-Coat finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm) Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and backing finish.
 - 3. 2-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - 4. Acrylic Polyurethane: Basis of Design; Matthews Acrylic Polyurethane Ultra Low VOC, a minimum dry film thickness of 2 mils. Comply with coating manufacturer's written instructions for cleaning, coating, and applying and backing finish.

2.4 ACCESSORIES

- A. Mounting Methods: Use double sided vinyl tape and silicone adhesive fabricated from materials that are not corrosive to sign materials and mounting surface.

- B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use oval countersunk screws and bolts with tamper-resistant, Allen-head slots unless otherwise indicated.

2.5 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress exposed and contact surfaces.
 - 2. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 3. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 4. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
 - 5. Internally brace signs for stability and for securing fasteners.
 - 6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.

2.6 INTERIOR FABRICATED SIGNAGE

- A. Illuminated – Halo Lit Fabricated Channel Characters (101400.A12): Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.
 - 1. Illuminated Characters: Halo-lit character construction with LED lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
 - a. Power: As required for illumination indicated on drawings, coordinate with electrical drawings.
 - 2. Character Material: Sheet or plate aluminum.
 - 3. Material Thickness: Manufacturer's standard for size and design of character.
 - 4. Character Height and Depth: As indicated on drawings for overall. Depth: No less than 1-1/2".
 - 5. Finishes:
 - a. Acrylic Polyurethane in color as selected by Architect from manufacturer's full range.
 - b. Overcoat: Manufacturer's standard baked-on clear coating.
 - 6. Mounting: As indicated.
 - a. Hold characters at distance as selected by Architect from wall surface.
 - 7. Typeface: As selected by Architect from manufacturer's full range.
 - 8. Welding: Use welding method that is appropriate for metal and finish indicated and that develops full strength of members joined. Finish exposed welds and surfaces smooth, flush, and blended to match adjoining surfaces.

2.7 EXTERIOR FABRICATED - SIGNAGE

- A. Illuminated – Halo Lit Fabricated Channel Characters (101400.A12): Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.
 - 1. Illuminated Characters: Halo-lit character construction with LED lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
 - a. Power: As required for illumination indicated on drawings, coordinate with electrical drawings.
 - b. Weeps: Provide weep holes to drain water at lowest part of exterior characters. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
 - 2. Character Material: Sheet or plate aluminum.
 - 3. Material Thickness: Manufacturer's standard for size and design of character.
 - 4. Character Height and Depth: As indicated on drawings for overall. Depth: No less than 1-1/2".
 - 5. Finishes:
 - a. Acrylic Polyurethane in color as selected by Architect from manufacturer's full range.
 - b. Overcoat: Manufacturer's standard baked-on clear coating.
 - 6. Mounting: As indicated.
 - a. Hold characters at distance as selected by Architect from wall surface.
 - 7. Typeface: As selected by Architect from manufacturer's full range.
 - 8. Welding: Use welding method that is appropriate for metal and finish indicated and that develops full strength of members joined. Finish exposed welds and surfaces smooth, flush, and blended to match adjoining surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Verify that items provided under other sections of Work are sized and located to accommodate signs.
- E. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.
- G. Field verify dimensions of all conditions.

3.2 INSTALLATION, GENERAL

- A. Cast-Metal Plaques: Mount plaques using standard fastening methods to comply with manufacturer's written instructions for type of wall surface indicated.
 - 1. Face Mounting: Mount plaques using exposed fasteners with rosettes attached through face of plaque into wall surface.
- B. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

- C. Wall-Mounted Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.
- D. Wall-Mounted Signs on Smooth Surfaces: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces. Where signage is located on exterior surfaces, provide exterior rated adhesive as recommended by signage manufacturer for substrate indicated.
- E. Vertical Tolerance: Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1m).

3.3 INSTALLATION - FABRICATED SIGNAGE

- A. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
 - 3. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

3.4 INSTALLATION – VINYL FILM SIGNAGE

- A. Field-Applied, Vinyl-Film Signs:
 - 1. Preparation
 - a. Acclimatize materials by removing them from packaging in the installation areas not less than 24 hours before installation.
 - b. Follow manufacturer's printed instructions for surface preparation.
 - 1) Prepare substrates to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, and defects.
 - 2) Painted surfaces: Treat areas susceptible to pigment bleeding.
 - 3) Metals: If not factory-primed, clean and apply rust inhibitive zinc primer.
 - 4) Moisture content: maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 5) Adhesion Test: Perform manufacturer's standard non-destructive adhesion test on substrate, prime or repaint all surfaces that fail adhesion test as recommended by manufacturer.
 - 2. Installation:
 - a. Align sign Characters in final position before removing release liner. Remove release liner in stages and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.
 - b. For textured substrates, install using 3M Textured Surface Applicator as recommended or required by manufacturer for best installation practices for a warranted installation.
 - 3. Cleaning
 - a. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

3.5 INSTALLATION – EXTERIOR SIGNAGE

- A. Preparation
 1. They must be stored in an area free and clear of work. They should be properly acclimated to prevent bowing and cupping of signage.
 2. Install only after all other work is completed.
 3. Coordination between trades to ensure district guidelines are achieved.
- B. Installation:
 1. Install components in locations and heights as indicated on Drawings. Attach using concealed system. Utilize mechanical fasteners appropriate for exterior use and prevent staining. Keep all lines straight, level, and plumb. Align components with the installation of adjacent components.
 2. For textured substrates, install using 3M Textured Surface Applicator as recommended or required by manufacturer for best installation practices for a warranted installation.
- C. Cleaning
 1. Follow manufacturer’s written instructions.
 2. Cover up visual display surfaces after installation if directed by Owner or Architect.

3.6 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.
- B. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes to components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- C. Remove temporary protective coverings and strippable films as signs are installed.
- D. On completion of installation, clean exposed surfaces of signs according to manufacturer’s written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean conditions during construction and protect from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 101423 – ADA AND CODE SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Wayfinding Panel Signage (101423.A04):
 - a. Interior Room signage.
 - b. Custom fabricated polymer plastic signage.
- B. Related Sections include the following:
 - 1. Section 012100 "Allowances" for interior room signage and exterior door signage.
 - 2. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.
 - 3. Section 101400 "Signage" for related graphics and signage.
 - 4. Division 26 Section "Interior Lighting" and "Exterior Lighting" for illuminated signs.

1.2 DEFINITIONS

- A. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."
- B. Signage Contractor: Contractor responsible for the fabrication and installation of signage unless responsibility for fabrication or installation is called out by others in the drawings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Including but not limited to, the following:
 - 1. Manufacturer's technical product data for each type of product specified. Include data on physical characteristics, durability, fade resistance, flame resistance and manufacturing process.
 - 2. Product data shall show compliance with requirements for fire performance characteristics and physical properties.
- B. Shop Drawings: Show fabrication and installation details for signs.
 - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
 - 3. Include fabrication and installation details, and attachments to other work.
 - 4. Include elevations, component details, and attachments to other work for wayfinding signage.
 - 5. Indicate materials and profiles of signage fittings, joinery, finishes, fasteners, anchorages, and accessory items.
 - 6. Field Dimensions shall be obtained, reviewed, and accepted by signage manufacturer prior to submittal of shop drawings.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for the following:
 - 1. Aluminum.
- D. Samples for Verification:
 - 1. Sample from same flitch to be used for the Work, with specified finish applied.
 - 2. Submit full-size samples of wayfinding signage. Quantity and type shall be determined by Architect with intent of one sample per each signage type representative of all types of products indicated.
- E. Sign Schedule: Use same designations indicated on Drawings.

- F. Mockups/Field Samples: Build mockups/field samples to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Warranty: Special warranty specified in this Section.
- C. Provide written documentation that the braille translation included on the manufacturer's signage provided in this section has been evaluated by the American Foundation for the Blind, and is, in their opinion, correct and compliant with ADAAG.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Fabricator Qualifications: A firm that employs skilled workers experienced in producing custom-fabricated products similar to those required for this Project and with at least seven years continuous experience under the current company name. Fabricator shall have a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - 1. Fabricator shall have completed at least seven (7) similar signage projects having similar requirements within the last four (4) years for each signage type.
- C. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- D. Regulatory Requirements: Comply with applicable provisions in ADA-ABA Accessibility Guidelines.
- E. Fire Performance Characteristics: Provide wall coverings with the following surface burning characteristics as determined by testing identical products per ASTM E 84 by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify wall coverings with appropriate markings of applicable testing and inspecting organization.
 - 1. Flame Spread: 5 or less.
 - 2. Smoke Developed: 25 or less.
- F. ADA Accessibility Guidelines: Signage shall comply with the ADA Accessibility Guidelines where applicable. Characters and graphics, including but-not limited to, copy height, letter stroke symbols, materials, and finishes indicated on the Drawings are intended as guidelines for compliance. Implement each applicable ADA guideline. Should conflicts arise, notify the Designer before proceeding.

1.7 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Required parties include the contractor, sub-contractor and architect/designer.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review temporary protection requirements for during and after installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations for Exterior Signage: Proceed with installation only when existing and forecasted weather conditions permit installation of signs in exterior locations to be performed according to manufacturers' written instructions and warranty requirements.
- B. Interior Environmental Limitations: Do not deliver and install vinyl wall graphics until spaces are enclosed and weathertight, wet work in spaces to receive murals is complete and dry, work above ceilings is complete, and temporary or permanent HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 1. Maintain a constant temperature not less than 60 deg F in installation areas for at least 10 days before and 10 days after installation.
- C. Lighting: Do not install vinyl wall graphics until permanent level of lighting is provided on the surfaces to receive murals.
- D. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by the vinyl wall graphics manufacturer for full drying and curing.
- E. Field Measurements: Verify recess openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install ADA and Code Signage units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Use special care in handling to prevent twisting, warping, nicking, and other damage to signage. Store materials to permit easy access for inspection and identification.
- B. Store signage in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.11 COORDINATION

- A. Coordinate placement of anchorage devices with templates for installing signs.
 - 1. For signage furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metal and polymer finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image colors.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs. **(1.6.H)**

2.2 MATERIALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.
 - 1. Plate and Sheet: ASTM B 209, Alloy 3003-H14, Alloy 5005-H32 or Alloy 6061-T6.
 - 2. Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
 - 3. Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. PETG (Polyethylene Terephthalate Glycol) Sheet: ASTM D 5047-17 category as standard with manufacturer for each sign.
 - 1. Tensile Strength: 7,700 lbf/sq. in. per ASTM D 638.
 - 2. Flexural Modulus of Elasticity: 310,000 lbf/sq. in. per ASTM D 790.
- E. Photopolymer Sheet: Manufacturer's recommended photopolymer for producing integral non-laminated raised copy.
- F. Polycarbonate Sheet: Of thickness indicated, manufactured by extrusion process, ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), coated on both surfaces with abrasion-resistant coating:
 - 1. Impact Resistance: 16 ft-lbf/in. per ASTM D 256, Method A.
 - 2. Tensile Strength: 9000 lbf/sq. in. per ASTM D 638.
 - 3. Flexural Modulus of Elasticity: 340,000 lbf/sq. in. per ASTM D 790.
 - 4. Heat Deflection: 265 deg F at 264 lbf/sq. in. per ASTM D 648.
 - 5. Abrasion Resistance: 1.5 percent maximum haze increase for 100 revolutions of a Taber abraser with a load of 500 g per ASTM D 1044.
- G. Expanded PVC Sheet: Subject to compliance with requirements, provide "Sintra" by 3A Composites.
 - 1. Material: Moderately expanded closed-cell polyvinyl chloride.
 - 2. Color: As selected by Architect from manufacturer's full range.
- H. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.3 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Aluminum Finishes
 - 1. Clear Anodic Finish: Manufacturer's standard Class 1 clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured) mechanical finish, complying with AAMA 611.

- E. Acrylic Sheet Finishes
 - 1. Colored Coatings for Acrylic Sheet: For copy and background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and that are UV and water resistant for five years for application intended.

2.4 ACCESSORIES

- A. Mounting Methods: Use double sided vinyl tape and silicone adhesive fabricated from materials that are not corrosive to sign materials and mounting surface.
- B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use oval countersunk screws and bolts with tamper-resistant, Allen-head slots unless otherwise indicated.

2.5 FABRICATION

- A. General: Provide manufacturer's standard signs of configurations indicated.
 - 1. Mill joints to tight, hairline fit. Form joints exposed to weather to exclude water penetration.
 - 2. Preassemble signs in the shop to greatest extent possible. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in location not exposed to view after final assembly.
 - 3. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.
 - 4. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Sign Message Panels: Construct sign-panel surfaces to be smooth and to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally from corner to corner.
 - 1. Increase panel thickness or reinforce with concealed stiffeners or backing materials as needed to product surfaces without distortion, buckles, warp, or other surface deformations.

2.6 WAYFINDING PANEL SIGNAGE – ROOM SIGNAGE (101423.A01)

- A. General: Panel signs shall be acrylic or photopolymer signs with insert window, with an overall thickness of approximately 5/16 inch. Existing signs were constructed as follows:
 - 1. Provide back sheet of 1/8 inch thick acrylic with first surface painted.
 - 2. Provide 1/16 inch spacer for insert window.
 - 3. Provide 1/8 inch thick photopolymer with first surface painted.
 - 4. Provide painted edges for solid appearance.
 - 5. Provide white raised numbers and braille, unless otherwise indicated or required by code.
- B. 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. Ad Trends.
 - 2. Acme.
 - 3. ASI-Modulex, Inc.
 - 4. Innerface Sign Systems, Inc.
 - 5. Nova.
 - 6. Star Signs.
 - 7. Take Form.

8. 2/90 Sign Systems.
- C. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.
 - D. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of slide-in inserts.
 - E. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.
 - 1. Raised-Copy Thickness: Not less than 1/32 inch.
 - F. Subsurface Copy: Apply minimum 4-mil-thick vinyl copy to back face of clear acrylic sheet forming panel face to produce precisely formed opaque image. Image shall be free of rough edges.
 - G. Colored Coatings for Acrylic Sheet: For copy background colors, provide colored coatings, including inks, dyes, and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are UV and water resistant for five years for application intended.
 - 1. Color: As selected by Architect from manufacturer's full range.
 - H. Sign Types – General: There will be one type with tactile/Braille to match existing interior signage to best extent possible as acceptable to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Verify that items provided under other sections of Work are sized and located to accommodate signs.
- E. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.
- G. Field verify dimensions of all conditions.

3.2 INSTALLATION, GENERAL

- A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.
 - 1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
- B. Wall-Mounted Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

- C. Wall-Mounted Signs on Smooth Surfaces: Comply with sign manufacturer's written instructions except where more stringent requirements apply.
 - 1. Silicone-Adhesive Mounting: Attach signs to irregular, porous, or vinyl-covered surfaces. Where signage is located on exterior surfaces, provide exterior rated adhesive as recommended by signage manufacturer for substrate indicated.

- D. Wall-Mounted Signs on Textured Surfaces: Comply with sign manufacturer's written instructions except where more stringent requirements apply. Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

- E. Vertical Tolerance: Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1m)

3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

- B. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes to components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

- C. Remove temporary protective coverings and strippable films as signs are installed.

- D. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean conditions during construction and protect from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Phenolic toilet compartments configured as toilet enclosures (102113.A01).
 - 2. Phenolic urinal screens (102113.A02).
- B. Related Sections:
 - 1. Section 061000 "Rough Carpentry" for blocking.
 - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, and similar accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments and urinal screens. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show layout and size of each toilet compartment.
 - 2. Show layout and size for each urinal screen.
 - 3. Show locations of cutouts for compartment-mounted toilet accessories.
 - 4. Show locations of centerlines of toilet fixtures.
 - 5. Show locations of floor drains.
- C. Samples for Initial Selection: For each type of unit indicated. Include Samples of compartment material involving texture and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
 - 1. Each type of material, color, texture, and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 75 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84 requirements for Class "B" or better; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 45 or less.
 - 2. Smoke-Developed Index: 110 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 PHENOLIC TOILET COMPARTMENTS – (102113.A01)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Scranton Products, "Eclipse 2" toilet enclosure units/urinal screens or comparable product by one of the following:
 - 1. Bradley Corporation; Mills Partitions.
 - 2. General Partitions Mfg. Corp.
 - 3. Knickerbocker Partition Corporation.
 - 4. Metpar Corp.
- B. Toilet-Enclosure Style: Floor-mounted overhead braced.
 - 1. Compartment Depth and Width: As scheduled and indicated on Drawings.
 - 2. Door Width: As scheduled and indicated on the Drawings.
 - 3. Height Above Floor: 4 inches, except where required higher for accessibility.
 - 4. Door/Panel Height: 72 inch
 - 5. Pilaster Height: As scheduled and indicated on Drawings.
- C. Urinal-Screen Style: Wall mounted with continuous brackets.
 - 1. Height above floor as indicated on drawing.
- D. Door, Panel, Screen, and Pilaster Construction: Solid, color through phenolic panel material on both faces, seamless, with eased edges, "no-sightline system" and with homogenous color and pattern throughout thickness of material.
 - 1. Material Thicknesses:
 - a. Doors, Pilasters: 3/4 inch.
 - b. Panels, Urinal Screen: 1/2 inch.
 - c. Compartments shall incorporate a lap joint at doors and pilasters to eliminate sightlines into stalls.
 - 2. Color and Pattern: One color, pattern and texture in each room.
 - a. Color and Pattern: As selected by Architect from manufacturer's full range.
 - 3. Provide "No-sightline" system.
- E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design. Type 304 stainless steel, No. 4 satin finish.
- F. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's continuous double ear bracket. Type 304 stainless steel, No. 4 satin finish.
- G. Warranty: 25 years.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
 - 1. Material: Clear-anodized aluminum or stainless steel.
 - 2. Hinges: Provide 8-inch, "wrap-around" hinges fabricated from aluminum in a bright anodized finish. Hinges shall have field adjustment capability. Hinge shall be self-closing to within 15 degrees of opening. Mount with through-bolts.
 - 3. Latch and Keeper: Manufacturer's standard surface-mounted occupancy indicator latch. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221, 6463-T5.
- C. Stainless-Steel Castings: ASTM A 743/A 743M.

2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Floor-Mounted Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
 - 1. Each pilaster over 3 inches wide shall be anchored to floor with a minimum of two (2) anchors to prevent twisting.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
 - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Tolerance: Maximum variation for plumb or level shall not exceed 1/8 inch.
 - 3. Continuous Brackets: Secure panels to walls and to pilasters with continuous brackets.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
 - 4. Equip each compartment door with one coat hook and bumper.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach screens to pilasters and walls with continuous brackets and anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.
- B. Clean exposed surfaces of compartment systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

3.4 FINAL PROTECTION

- A. Provide final protection and maintain conditions the ensure toilet compartments and screens are without damage and deterioration at time of Substantial Completion.
- B. If any damage occurs, replace unit(s), unless repairs acceptable to Architect can be made.
- C. Should damage occur to partition, door or pilaster in shipping, those damaged items shall be replaced within 30 days.

END OF SECTION 102113

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Childcare accessories.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.
- B. Related Sections:
 - 1. Section 093000 "Ceramic Tiling" for ceramic toilet and bath accessories.
 - 2. Section 102113 "Toilet Compartments".
- C. Owner will furnish, and contractor install the following accessories:
 - 1. Soap dispensers.
- D. Owner will furnish and install the following accessories:
 - 1. Waste receptacles.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
 - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.
- B. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Soap Dispenser (102800.A05) – Provided by Owner, Installed by Contractor.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide products specified from Bobrick Washroom Equipment, Inc. or comparable products by one of the following:
 - 1. American Specialties, Inc.
 - 2. Bradley Corporation.
- C. Toilet Tissue Dispenser (102800.A01 - TTD):
 - 1. Basis-of-Design Product: Impact Products, LLC; Single Roll – Dispenser 2500.
 - 2. Description: Chrome Finished 18 gauge steel.
 - 3. Lockset: Self-locking mechanism.
- D. Combination Towel (Folded) Dispenser/Waste Receptacle (102800.A04 - PTDR):
 - 1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-3944 Series.
 - 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 - 3. Mounting: Recessed with projecting receptacle.
 - a. Designed for nominal 4-inch wall depth.
 - 4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
 - 5. Minimum Waste-Receptacle Capacity: 12 gal.
 - 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - 7. Liner: Reusable, vinyl waste-receptacle liner.
 - 8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

- E. Grab Bar (102800.A06 – GB, VGB):
 - 1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6806.99 Series.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 - 4. Outside Diameter: 1-1/2 inches.
 - 5. Configurations and Lengths:
 - a. Straight, 36 inches long behind accessible toilets.
 - b. Straight, 42 inches long to side of accessible toilets.
 - c. Straight, 18 inches long vertical, above and to front of 42 inch grab bar at side of accessible toilets.

- F. Sanitary-Napkin Receptor Unit (102800.A08 - SNR):
 - 1. Basis-of-Design Products:
 - A. Bradley: Model 4721-15 & 4722-15.
 - B. ASI: Model 0473-1A & 0472-1.
 - 1. Mounting: Surface.
 - 2. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
 - 3. Receptacle: Removable.
 - 4. Material and Finish: Stainless steel, No. 4 finish (satin).

- G. Mirror Unit (102800.A10 – M1, M2, M3):
 - 1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-290 Series.
 - a. Types:
 - 1) M1 – Shall be 24-inches wide x 36-inches height.
 - 2) M2 – No Used.
 - 3) M3 - Shall be 24-inches wide x 48-inches height.
 - 2. Frame Stainless-steel channel, in No.4 satin finish.
 - a. Corners: Manufacturer's standard, mitered.
 - 2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. Concealed wall hanger bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 - 3. Glazing: Provide polished tempered glass mirror in locker rooms and gym facilities. Provide polished non-tempered glass mirror in other locations unless noted otherwise.
 - 4. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - 5. Sizes: As indicated on Drawings.

2.3 CHILDCARE ACCESSORIES

- A. Surface-mounted Horizontal Baby Changer (102800.A20):
 - 1. Description: Horizontal type, satin SS, 4" depth when closed, anti-microbial.
 - 2. Koala Kare: KB110-SSWM.
 - 3. Bradley: Model 962-11.
 - 4. ASI: Model 9013-9.

2.4 UNDERLAVATORY GUARDS

- A. Underlavatory Guard (102800.A21):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plumberex Specialty Products, Inc.
 - b. Truebro by IPS Corporation.
 - 2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
 - 3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 103100 – MANUFACTURED FIREPLACES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pre-manufactured vented gas-fireplace.
- B. Related Sections:
 - 1. Section 061000 "Rough Carpentry" for wood blocking for screen installation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For fireplace. Show layout, rough-in requirements, elevations and sections of fireplace. Include the following:
 - 1. Location of wiring connections.
 - 2. Location of gas piping connections
 - 3. Anchorage details, including connection to supporting structure.
 - 4. Details of juncture of exposed surfaces with adjacent finishes.
 - 5. Accessories.
 - 6. Wiring diagrams.
- C. Samples for Initial Selection: For finishes of exposed fireplace surfaces.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fireplace to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Fireplace: Obtain fireplace from single manufacturer. Obtain accessories, including necessary mounting hardware, from fireplace manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Gas Components, Devices, and Accessories: Comply with all codes referenced by local authority having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Do not deliver or install fireplace until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Store fireplace in manufacturer's protective packaging and according to manufacturer's written instructions.

1.6 COORDINATION

- A. Coordinate layout and installation of fireplace with adjacent construction, including wall construction and electrical systems.

PART 2 - PRODUCTS

2.1 FIREPLACES

- A. General: Manufacturer's standard units consisting of fireplace, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Custom Gas-Powered, Direct Vent Fireplace: Pre-manufactured unit designed and fabricated for wall mounting, and as follows:
 - 1. Basis of Design Product: Subject to compliance with requirements, provide DaVinci Custom Fireplaces "Double Sided / See Thru 72" x 20" or a comparable product submitted to and accepted by the Architect prior to bidding.
 - 2. Product Description:
 - 1) Aggregate: Rock Ember.
 - 2) Liner: Black Paint Finish.
 - 3) Trim: 2 inch wide black painted.
 - b. Dimensions for Framing: Refer to manufacturers written instructions.
 - c. Dimensions of Unit: Refer to manufacturers written instructions.
 - d. Heat Output: 72,500 BTU/hr; 14,500 BTU's per foot.
 - e. Glass Type: Manufacturer's Standard for design of unit.
 - f. Venting: Top with direct vent to roof system.
 - g. Controller: "TouchSmart" Wall Control.
 - 3. Warranty: Manufacturer's standard warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fireplace at locations indicated to comply with fireplace manufacturer's written instructions.
- B. Install fireplace in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a secure manner, with edges plumb and level.
 - 1. Test fireplace units to verify that controls, and other operating components are in optimum functioning condition.

3.2 PROTECTION AND CLEANING

- A. Provide temporary covering of fireplace until time of Substantial Completion. Use type of covering approved by manufacturer that will effectively protect fireplace from abrasion, breakage, or other damage.
- B. Clean fireplace immediately before date scheduled for inspection intended to establish date of Substantial Completion. Use methods and cleaning materials recommended by manufacturer, taking care not to scratch or damage trim and screen substrates.

END OF SECTION 103100

SECTION 104413 - FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
 - 1) Provide fire extinguishers for each fire extinguisher cabinet.
- B. Related Sections:
 - 1. Section 099123 "Interior Painting" for cabinet finishing.
 - 2. Section 104416 "Fire Extinguishers."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
 - 1. Coordinate sizes and locations of fire protection cabinets with wall depths

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

2.2 FIRE PROTECTION CABINET (104413.A01)

- A. Cabinet Type: Suitable for fire extinguisher. Cabinet style to match existing on site.
 - 1. Basis of Design Products: Subject to compliance with requirements provide:
 - a. FE-1 - Semi-Recessed Non-rated Cabinets: Larsen's Manufacturing Company; Architectural Series
 - 1) Larsen's Manufacturing Company; "Architectural Series" with rolled edge.
 - a) Door style: Vertical Duo.
 - 2) Comparable products from the following meeting specified requirements:
 - a) J. L. Industries, Inc., a division of Activar Construction Products Group.
 - b) Potter Roemer LLC.

- B. Cabinet Construction: Nonrated and Rated.
- C. Cabinet Material: Cold-rolled steel.
- D. Semi-recessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semi-recessed cabinet installation.
 - 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Cold-rolled steel.
- G. Door Style: Vertical Duo with frame.
- H. Door Glazing: Impact-resistant clear acrylic.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- K. Finishes:
 - 1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet.
 - 2. Exterior to be field painted to match adjacent wall.

2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames of one-piece construction with edges flanged.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are 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.

2.5 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning". After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- C. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet manufacturers.
- D. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - b. Larsens Manufacturing Company.
 - c. Potter Roemer LLC.
 - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type (104416.A01): UL-rated 3-A:40-B:C nominal capacity, with mono-ammonium phosphate-based dry chemical in manufacturer's standard enameled container.
- C. General Designations:
 - 1. "FE-1" designates a Semi-recessed cabinet-mounted dry chemical fire extinguisher (104416.A01).
 - 2. "FE-2" designates a bracket-mounted dry chemical fire extinguisher (104416.A02).

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 48 inches above finished floor to top of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Knocked-down kitchen lockers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of metal locker.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.
- B. Shop Drawings: For metal lockers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Show locker trim and accessories.
 - 3. Include locker identification system and numbering sequence.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.
- D. Samples for Verification: For the following products, in manufacturer's standard size:
 - 1. Lockers and equipment.
- E. Product Schedule: For lockers. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 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. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:
 - a. Locks.
 - b. Identification plates.
 - c. Hooks.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Deliver master and control keys and combination control charts to Owner by registered mail or overnight package service.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain metal lockers, locker benches, and accessories from single source from single locker manufacturer.
 - 1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.3 KNOCKED-DOWN CORRIDOR (STAFF) AND KITCHEN LOCKERS (105113.A01)

- A. General: Location
- B. Basis-of-Design Product: Subject to compliance with requirements, provide lockers from one of the following:
 - 1. Art Metal Products.
 - 2. List Industries Inc.
 - 3. Lyon Workspace Products, LLC.
 - 4. Penco.
 - 5. Republic Storage Systems Company.
- C. Locker Types:
 - 1. Double-Tier.
- D. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
 - 2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
 - 3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
 - 4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
 - 5. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.

6. Door Style: Vented panel as follows:
 - a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier and two louver openings at top and bottom, or three louver openings at top or bottom, for box lockers.

- E. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:
 1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
 2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
 3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.

- F. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.
 1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

- G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees. Provide one of the following types:
 1. Knuckle Hinges: Steel, full loop (to wrap around pin), five or seven knuckles, tight pin; minimum 2 inches high. Provide no fewer than three hinges for each door more than 42 inches high.
 2. Continuous Hinges: Manufacturer's standard, steel, full height.

- H. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
 1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
 - a. Latch Hooks: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
 - b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

- I. Door Handle and Latch for Box Lockers: Stainless-steel strike plate with integral pull; with steel padlock loop that projects through metal locker door.

- J. Locks: Built-in combination locks.

- K. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

- L. Hooks: Manufacturer's standard ball-pointed type hooks, aluminum or steel; zinc plated.

- M. Coat Rods: Not less than 1-inch- diameter steel tube or rod, chrome finished.

- N. Continuous Sloping Tops: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.
 1. Closures: Vertical-end type.

- O. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.

- P. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

- Q. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.

- R. Materials:
 1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

- S. Finish: Baked enamel or powder coat.
 - 1. Color: As selected by Architect from manufacturer's full range.

2.4 LOCKS

- A. Combination Padlocks: Provided by Owner.
- B. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.
 - 1. Bolt Operation: Automatically locking spring bolt.

2.5 FABRICATION

- A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
 - 1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 - 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Equipment: Provide each locker with an identification plate and the following equipment:
 - 1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
 - 2. Coat Rods: As indicated on Drawings.
- D. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.
- E. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.
- F. Accessible Lockers: Fabricate as follows:
 - 1. Locate bottom shelf no lower than 15 inches above the floor.
 - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- G. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.
- H. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- I. Boxed End Panels: Fabricated with 1-inch-wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.6 ACCESSORIES

- A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- B. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.
 - 1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 - 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
 - 3. Anchor back-to-back metal lockers to floor.
- B. Knocked-Down Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.
- D. Equipment:
 - 1. Attach hooks with at least two fasteners.
 - 2. Attach door locks on doors using security-type fasteners.
 - 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
- E. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
 - 1. Attach recess trim to recessed metal lockers with concealed clips.
 - 2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 - 3. Attach sloping-top units to metal lockers, with closures at exposed ends.
 - 4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
- F. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.
- G. Freestanding Locker Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following types of roller shades:
 - 1. Manually operated roller shades with single rollers (122413.A01).
- B. Related Sections include the following:
 - 1. Section 012300 "Alternates" for alternates effecting work of this Section.
 - 2. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
 - 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each colored component of each type of shade indicated.
 - 1. Include similar Samples of accessories involving color selection.
 - 2. Include 4 inch square actual samples of shade fabric for Architect's selection.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
- D. Product Standard: Provide roller shades complying with WCMA A 100.1.
- E. Anti-Microbial Characteristics: 'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC9644 AND ATCC9645.

- F. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, lead-free designation, and location of installation using same designations indicated on Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 2 percent of quantity installed for each size, color, and shadeband material indicated, but not fewer than two units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product for Manually Operated Roller Shades (122413.A01): Subject to compliance with requirements, provide MechoShade Systems, Inc.; "Mecho/5 Slimline" or a comparable product by one of the following:
 - 1. Draper Inc.
 - 2. Hunter Douglas, Inc.; Hunter Douglas Window Fashions Division.
 - 3. Levolor; Levolor-Kirsch Window Fashions; a Newell Rubbermaid Company.
 - 4. Nysan Shading Systems Ltd.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS (122413.A01)

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Stainless steel.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Chain tensioner, jamb mounted.
 - 2. Spring Lift-Assist Mechanisms: When recommended by roller shade manufacturer for proper operation of shade, provide manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
 - a. Provide for shade bands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide

with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade bands for service.

1. Roller Drive-End Location: Right side of inside face of shade or left side of inside face of shade as determined by Architect.
 2. Direction of Shadeband Roll: Regular, from back of roller.
 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- E. Shadebands:
1. Shadeband Material: Light-filtering fabric.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
- F. Installation Accessories:
1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 3 inches.
 2. Endcap Covers: As required by manufacturer, provide to cover exposed endcaps.
 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade Systems, Inc.; "ThermoVeil" Dense Basket Weave 1300 Series or Dense Linear Weave 1000 Series as determined by Architect, or comparable product from other roller shade manufacturers submitted to and accepted by Architect prior to bidding.
- C. Light-Filtering Fabric: Visually transparent, woven non-raveling single-fabric, stain and fade resistant shade cloth.
1. Source: Roller-shade manufacturer.
 2. Type: Woven from extruded vinyl yarn comprised of 21 percent polyester and 79 percent reinforced vinyl.
 3. Thickness: 0.030 inch.
 4. Weight: Manufacturer's standard.
 5. Roll Width: Manufacturer's standard width up to 126 inches.
 6. Orientation on Shadeband: As indicated on Drawings.
 7. Openness Factor: 3 percent.
 8. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER SHADE FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
1. Lifting Mechanism: With permanently lubricated moving parts.
- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
1. Shade Units Installed Outside Jamb: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.

- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- G. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 4 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

3.3 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- B. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123669 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quartz agglomerate countertops.
 - 2. Quartz agglomerate backsplashes.
 - 3. Quartz agglomerate end splashes.
 - 4. Quartz agglomerate apron fronts.
- B. Related Requirements:
 - 1. Section 224100 "Residential Plumbing Fixtures" for sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.
 - 2. Wood trim, 8 inches long.
 - 3. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS (125669.A01 – SS1, SS2)

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
 - 1. Colors and Patterns: As indicated on the Material Finish Legend.
- B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at outside corner to match top.
 - 3. End Splash: Matching backsplash.
- C. Countertops: 3/4-inch thick, quartz agglomerate with front edge built up with same material.
- D. Backsplashes: 3/4-inch thick, quartz agglomerate[with wood-trimmed edges].
- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- F. Joints: Fabricate countertops without joints.
- G. Joints: Fabricate countertops in sections for joining in field, Architect to indicate with joints at locations indicated on the shop drawings.
 - 1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
 - 2. Joint Type: Bonded, 1/32 inch or less in width.
 - 3. Joint Type: Grouted, 1/16 inch in width.
 - 4. Joint Type: Sealant filled, 1/16 inch in width.
 - 5. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.
- H. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
 - c. Provide 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 1. Install metal splines in kerfs in countertop edges at joints where indicated. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123669

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural-steel framing.
 - 2. Metal roof panels.
 - 3. Metal wall and soffit panels.
 - 4. Thermal insulation.
 - 5. Personnel doors and frames.
 - 6. Accessories.

- B. Related Requirements:
 - 1. Section 012200 "Unit Prices" for unit prices effecting the work of this section.
 - 2. Section 074113 "Standing Seam Metal Roofing" for standing seam metal roofing not in the work of this Section.
 - 3. Section 074213 "Formed Metal Wall and Soffit Panels" for metal wall and soffit panels contained in the work of this Section.
 - 4. Section 077200 "Roof Accessories" for roof hatches.
 - 5. Section 081113 "Hollow Metal Doors and Frames" for hollow metal doors and frames.
 - 6. Division 23 for mechanical units and requirements affecting the work of this section.

1.2 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.
 - 2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
 - b. Structural limitations of purlins and rafters during and after roofing.
 - c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 - d. Temporary protection requirements for metal roof panel assembly during and after installation.
 - e. Roof observation and repair after metal roof panel installation.

3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
 - a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
 - b. Structural limitations of girts and columns during and after wall panel installation.
 - c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
 - d. Temporary protection requirements for metal wall panel assembly during and after installation.
 - e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Metal roof panels.
 - b. Metal wall and soffit panels.
 - c. Thermal insulation and vapor-retarder facings.
 - d. Personnel doors and frames.
- B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:
 1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
 2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
 - a. Show provisions for attaching roof curbs and other items requiring structural attachments indicated on Drawings.
 3. Metal Roof, Wall and Soffit Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
 - a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
 - b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.
 4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For the following products:
 1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
 3. Vapor-Retarder Facings: Nominal 6-inch-square Samples.
 4. Accessories: Nominal 12-inch-long Samples for each type of accessory.
- E. Door Schedule: For doors and frames. Use same designations indicated on Drawings. Include details of reinforcement.
 1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets indicating complete designations of every item required for each door or opening.
 2. Keying Schedule: Detail Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.
- F. Delegated-Design Submittal: For metal building systems.
 1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For erector and manufacturer.
- B. Welding certificates.
- C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
 - 1. Name and location of Project.
 - 2. Order number.
 - 3. Name of manufacturer.
 - 4. Name of Contractor.
 - 5. Building dimensions including width, length, height, and roof slope.
 - 6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
 - 7. Governing building code and year of edition.
 - 8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
 - 9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
 - 10. Building-Use Category: Indicate category of building use and its effect on load importance factors.
- D. Erector Certificates: For qualified erector, from manufacturer.
- E. Material Test Reports: For each of the following products:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shop primers.
 - 5. Nonshrink grout.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
- I. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panel finishes and door hardware to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
 - 1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
 - 2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.
- B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.

2. Build mockups for typical wall metal panel including accessories.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 25 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Products: Subject to compliance with requirements, provide products by Varco Pruden meeting the requirements of this Section.
 1. At the request of the Owner, substitutions for these products will not be allowed.
- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.
 1. Where different manufacturers are indicated as basis of design requirements, products shall be sourced through the metal building manufacturer.

2.2 SYSTEM DESCRIPTION

- A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
- B. Primary-Frame Type:
 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Engineer end walls to be expandable. Provide primary frame, capable of supporting full-bay design loads, and end-wall columns.

- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and outset-framed girts.
 - 1. Coordinate with location of exterior metal panel location as indicated on drawings. Refer to base detail for exterior metal panels.
- E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.
- F. Bay Spacing: As indicated on Drawings.
- G. Roof Slope: As indicated otherwise on Drawings.
- H. Roof System: Double Lock standing-seam, vertical-rib, metal roof panels.
 - 1. Basis of Design: Subject to compliance with requirements, provide "SSR – 22 Gauge" by Varco Pruden or a comparable product meeting specified product characteristics submitted to and accepted by Architect prior to bidding by one of the manufacturers listed in Paragraph 2.1.
 - 2. Size: 24 inches wide with double lock seamed joints, 2 inches in height.
 - 3. Description: Roll formed panels seamed at 24 inches on center.
 - a. Flat of Panel: Cross flutes 46 inches on center, perpendicular to major corrugations in entire length of panel to reduce wind noise.
 - b. Material: 22 gauge steel coated both sides with layer of acrylic-coated galvalume aluminum-zinc alloy (approximately 55% aluminum, 45% zinc) applied by continuous hot-dip method. Minimum 0.55 ounce coated weight per square foot per triple spot test in ASTM A792. Apply clear acrylic film for additional protection.
 - c. Finish: Two-Coat Fluoropolymer: AAMA 2605. Two-coat fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - d. Color: As selected by Architect from manufacturer's full range.
- I. Exterior Wall and Soffit System:
 - 1. Refer to Section 074213 for product information and requirements regarding metal wall and soffit panels.
 - 2. Products required to be installed on metal building assembly shall be sourced through and installed by the the metal building manufacturer.

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
 - 1. Design Loads: As indicated on Drawings.
 - 2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
- E. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 or ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- F. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.

- G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- H. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- J. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 - 1. Fire/Windstorm Classification: Class 1A- 90.
 - 2. Hail Resistance: MH.
- K. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C 1363 or ASTM C 518:
 - 1. Roof:
 - a. R-Value: R-30.
 - 2. Walls:
 - a. R-Value: R-19.

2.4 STRUCTURAL-STEEL FRAMING

- A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."
- B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.
- D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
 - 1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
 - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
 - 2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
 - 3. Frame Configuration: Single gable.
- E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
 - 1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
 - 2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
 - 1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.
 - a. Depth: As needed to comply with system performance requirements.
 - 2. Purlins: Steel joists of depths indicated on Drawings.
 - 3. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch-wide flanges.

- a. Depth: As required to comply with system performance requirements.
 4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
 5. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 6. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
 7. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
 8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
 9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
 10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- G. Bracing: Provide adjustable wind bracing using any method as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50; or ASTM A 529/A 529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
 2. Cable: ASTM A 475, minimum 1/4-inch-diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
 3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 5. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
- H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.
- I. Materials:
1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
 3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.
 4. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
 5. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
 6. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
 7. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
 8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
 - b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, SS, Grade 50 or 80; with Class AZ50 coating.
 9. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for primary framing.
 10. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
 - a. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
 11. Structural Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - a. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
 12. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with spline ends; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

13. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
 - a. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50, baked-epoxy coated.
 14. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: ASTM F 436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
 15. Headed Anchor Rods: ASTM F 1554, Grade 36.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 heavy-hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: ASTM F 436 hardened carbon steel.
 - e. Finish: Hot-dip zinc coating, ASTM F 2329, Class C.
- J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.
1. Clean and prepare in accordance with SSPC-SP2.
 2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
 - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 FABRIC FACED ROOF AND WALL INSULATION SYSTEM

- A. Basis of Design: Subject to compliance with requirements provide "Simple Saver System" by Thermal Design or a comparable product submitted to and accepted by Architect prior to bidding with the following product characteristics.
1. Total Insulation R-Value: R-30
 2. Average installed thickness: 9 inches.
 3. A thermal block shall be applied where there is no existing thermal break between metal panel and metal structure. The thermal break shall be 3/16" x 3" foam tape or as recommended by manufacturer.
 4. Steel Strap: 100 KSI minimum yield high tensile strength steel, galvanized, primed and then painted the specified color on the exposed side with a clear coat primer on the unexposed side.
 - a. Minimum size shall be 0.02" x 1" x continuous length.
 - b. The strap color shall be UVMAX 8 White.
 - c. Transverse strap pattern shall include one strap 6 inches away from each rafter flange with remaining space between rafters divided into equal spaces not to exceed 5 feet.
 - d. Longitudinal straps shall be nominally 30 inches on center, with two adjacent straps at the ridge line.
 5. Fasteners:
 - a. For up to 12 ga purlins: #12 x 3/4", plated self-drilling screws with sealing washers painted to match the specified color for fastening to light gauge steel.
 - b. For up to 3/8" purlins/bar joists: #12 x 1 1/4" plated self-drilling screws with sealing washers, painted to match the specified color for heavier gauge steel.
 6. Fabric: Shall be woven reinforced high density polyethylene yarns coated on both sides with a continuous white or colored polyethylene film.
 - a. The fabric grade for the roof shall be Syseal FP in color selected by Architect to match existing.
 - b. The fabric shall comply with UL/ULC 723 or ASTM E84, and be Class A compliant with a low flame spread index of 25 or less based on ASTM E84 test standards.
 - c. This material shall be manufactured in large custom pieces by extrusion welding from roll goods. Pieces shall be fabricated to substantially fit the large defined building areas with minimum practical sealing. to be done on job site.
 - d. Fabric shall be folded to allow for rapid pull out on the strap support system.
 - e. The fabric shall be certified for free fall protection by the manufacturer.
 7. Sealants: As recommended by manufacturer for sealing laps of vapor barrier fabric.
 8. Insulation: Shall be formaldehyde-free fiberglass blanket or batt insulation meeting ASTM C991 Type 1, ASTM E136 and ASTM E84.
 9. Thermal Break (Block): Thermal break shall be 3/16" thick by 3" wide white, closed cell polyethylene foam with pre-applied adhesive film and peel-off backing, 3/8" polystyrene Snap-R thermal block. The selection shall be provided as a thermal break where there is no thermal break.

2.6 PERSONNEL DOORS AND FRAMES

- A. Swinging Personnel Doors and Frames: As specified in Section 081113 "Hollow Metal Doors and Frames."
- B. Hardware for Personnel Doors: As specified in Section 087100 "Door Hardware."

2.7 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
 - 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
 - 2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
 - 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet or nylon-coated aluminum sheet.
 - 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.
 - 1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
 - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
 - 1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
 - 2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."
 - 1. Gutter Supports: Fabricated from same material and finish as gutters.
 - 2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
- F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.
 - 1. Mounting Straps: Fabricated from same material and finish as gutters.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- H. Snow Guard Rails: Clamp on rails equal to Sno Blox.

- I. Materials:
 1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
 - a. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
 - b. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels.
 - c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
 4. Metal Panel Sealants:
 - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
 - b. Joint Sealant: ASTM C 920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.8 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
 1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
 2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
 1. Make shop connections by welding or by using high-strength bolts.
 2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
 3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
 4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
 5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
 1. Make shop connections by welding or by using non-high-strength bolts.
 2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
 1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written instructions and drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.
 - 1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
 - a. Joint Type: Snug tightened or pretensioned as required by manufacturer.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - 1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - 2. Locate and space wall girts to suit openings such as doors and windows.

3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
 2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
 - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
 2. Install metal panels perpendicular to structural supports unless otherwise indicated.
 3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Locate metal panel splices over structural supports with end laps in alignment.
 6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
- F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
 - 1. Install ridge caps as metal roof panel work proceeds.
 - 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
 - 1. Install clips to supports with self-drilling or self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
 - 4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
 - 6. Provide metal closures at peaks and each side of ridge caps.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
 - 2. Shim or otherwise plumb substrates receiving metal wall panels.
 - 3. When two rows of metal panels are required, lap panels 4 inches minimum.
 - 4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
 - 5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
 - 6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 - 7. Install screw fasteners in predrilled holes.
 - 8. Install flashing and trim as metal wall panel work proceeds.
 - 9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
 - 10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
 - 11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
 - 1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.

2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
 2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
 3. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 4. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
 - a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
 5. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.8 DOOR AND FRAME INSTALLATION

- A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840. Fit non-fire-rated doors accurately in their respective frames, with the following clearances:
1. Between Doors and Frames at Jamb and Head: 1/8 inch.
 2. Between Edges of Pairs of Doors: 1/8 inch.
 3. At Door Sills with Threshold: 3/8 inch.
 4. At Door Sills without Threshold: 3/4 inch.
- C. Field Glazing: Comply with installation requirements in Section 088000 "Glazing."
- D. Door Hardware:
1. Install surface-mounted items after finishes have been completed at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 4. Set thresholds for exterior doors in full bed of sealant complying with requirements for concealed mastics specified in Section 079200 "Joint Sealants."

3.9 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
1. Provide elbows at base of downspouts to direct water away from building.
 2. Tie downspouts to underground drainage system indicated.
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.10 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.
- B. Product will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.11 ADJUSTING

- A. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- B. Door Hardware: Adjust and check each operating item of door hardware and each door to ensure proper operation and function of every unit. Replace units that cannot be adjusted to operate as intended.

3.12 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

- D. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
 - 1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- F. Doors and Frames: Immediately after installation, sand rusted or damaged areas of prime coat until smooth and apply touchup of compatible air-drying primer.
 - 1. Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 133419

Project Manual Volume 2

Raytown Quality Schools

Herndon Restaurant

11501 East 350 Highway
Raytown, Missouri 64133

Prepared For:
Raytown Quality Schools
6608 Raytown Road
Raytown, MO 64113

Project Number: 17048
Issue Date: March 8, 2019

Contents:

Volume 1: Introductory Information, Bidding and Contracting Requirements,
Division 1 through Division 13.

Volume 2: Divisions 21 through 33 Specifications.



we design the future®

HOLLISANDMILLER.COM

1828 Walnut Street Suite 922 | Kansas City, MO 64108 | 816.442.7700
Missouri | Kansas | Colorado



DOCUMENT 000101 – PROJECT TEAM DIRECTORY

PROJECT: Herndon Restaurant
11501 E. 350 Highway
Raytown, Missouri 64133

OWNER: Raytown Quality Schools
6608 Raytown Road
Raytown, Missouri 64113

ARCHITECT: Hollis + Miller Architects, Inc.
1828 Walnut Street, Suite 922
Kansas City, Missouri 64108-1867
Contact: Sandy Cochran
Phone: 816.442.7700

STRUCTURAL ENGINEER: Hollis + Miller Architects, Inc.
1828 Walnut Street, Suite 922
Kansas City, Missouri 64108-1867
Contact: John Funk
Phone: 816.442.7700

MEP ENGINEER: Smith & Boucher, Inc.
25501 West Valley Parkway, Suite 200
Olathe, Kansas 66061
Contact: Kent McCosh
Phone: 913.345.2127

CIVIL ENGINEER: MKEC Engineering, Inc.
118127 W. 112nd Street, Suite 200
Overland Park, Kansas 66210
Contact: Brian Hill
Phone: 913.317.9390

FOOD SERVICE CONSULTANT: Santee Becker & Associates
6700 Squibb Road, Suite 101
Mission, Kansas 66202
Contact: John Kennedy
Phone: 913.362.1800

END OF DOCUMENT 000101

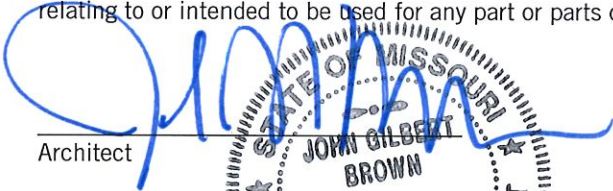
DOCUMENT 000105 – CERTIFICATIONS AND SEALS

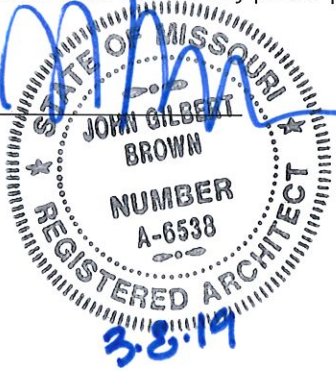
Architect:

I hereby state, pursuant to RSMo 327.411, that the Specifications intended to be authenticated by my seal are limited to Specification Sections listed below:

- Division 1 Sections
- Division 2 Sections
- Division 3 Section: 035416
- Division 5 Sections: 055000, 055100
- Division 6 Sections
- Division 7 Sections
- Division 8 Sections
- Division 9 Sections
- Division 10 Sections
- Division 11 Section: 116673
- Division 12 Sections
- Division 14 Section
- Division 31 Sections: 313116, 313200.

I hereby disclaim any responsibility for all other specifications, drawings estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project or survey.


Architect



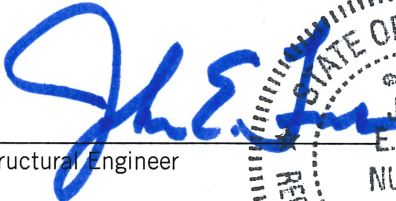
March 8, 2019
Date

Structural Engineer:


I hereby state, that the Specifications intended to be authenticated by my seal are limited to Specification Sections listed below:

Division 3 Section: 033000.
Division 4 Section: 042000.
Division 5 Section: 055213

I hereby disclaim any responsibility for all other specifications, drawings estimates, reports, or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project or survey.



Structural Engineer



Date

March 8, 2019

3/8/19

DOCUMENT 000105 - CERTIFICATIONS AND SEALS-MEP

Mechanical/Electrical/Plumbing Engineer

I hereby state, pursuant to RSMo 327.411, that the Specifications intended to be authenticated by my seal are limited to Specification Sections listed below:

- Division 21 Sections: 210500, 211100, 211313;
- Division 22 Sections: 220500, 220513, 220516, 220519, 220523, 220529, 220553, 220719, 221116, 221119, 221316, 221319, 221323, 224000, 224700;
- Division 23 Sections: 230500, 230529, 230553, 230593, 230713, 230719, 230900, 231123, 232113, 232300, 233113, 233300, 233416, 233713, 233813, 237413, 237423.13;
- Division 26 Sections: 260500, 260519, 260526, 260529, 260533, 260544, 260553, 260923, 260943, 262413, 262416, 262726, 262813, 262816, 265119, 265219, 265119;
- Division 27 Sections: 270500, 270526, 270528, 271100;
- Division 28 Sections: 283111.

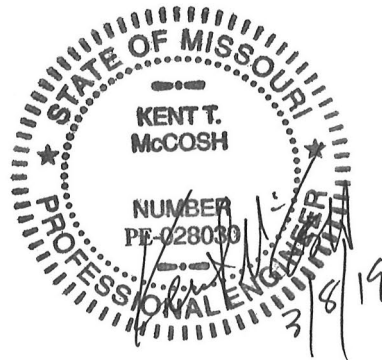
I hereby disclaim any responsibility for all other specifications, drawings estimates, reports or other documents or instruments relating to or intended to be used for any part or parts of the architectural or engineering project or survey.



Kent T. McCosh, P.E., LEED® AP

3/8/19

Date



DOCUMENT 0001100 – TABLE OF CONTENTS

Raytown Quality Schools – Herndon Restaurant
 11507 East State Route 350
 Raytown, Missouri

Project No. 17048

	CURRENT ISSUE <u>DATE</u>	ORIGINAL ISSUE <u>DATE</u>	
INTRODUCTORY INFORMATION			
000101	Project Team Directory	03.08.19	03.08.19
000105	Certifications and Seals	03.08.19	03.08.19
000110	Table of Contents	03.08.19	03.08.19
BIDDING REQUIREMENTS			
001100	Invitation to Bid	03.08.19	03.08.19
002100	Instructions to Bidders	03.08.19	03.08.19
002200	Supplementary Instructions to Bidders	03.08.19	03.08.19
003132	Geotechnical Data	03.08.19	03.08.19
004200	Proposal Form	03.08.19	03.08.19
004313	Bid Security Form	03.08.19	03.08.19
004513	Bidder’s Qualifications	03.08.19	03.08.19
CONTRACTING REQUIREMENTS			
005200	Agreement Form	03.08.19	03.08.19
006113	Performance and Payment Bond	03.08.19	03.08.19
006273	Application and Certification for Payment	03.08.19	03.08.19
006275	Partial Lien Waiver	03.08.19	03.08.19
006276	Bailment Receipt	03.08.19	03.08.19
006277	Bill of Sale	03.08.19	03.08.19
007200	General Conditions	03.08.19	03.08.19
007300	Supplementary Conditions	03.08.19	03.08.19
008100	Prevailing Wage Determination	03.08.19	03.08.19
008400	Attachments	03.08.19	03.08.19
DIVISION 1 – GENERAL REQUIREMENTS			
001100	Summary	03.08.19	03.08.19
012100	Allowances	03.08.19	03.08.19
012200	Unit Prices	03.08.19	03.08.19
012300	Alternates	03.08.19	03.08.19
012500	Substitution Procedures	03.08.19	03.08.19
012600	Contract Modification Procedures	03.08.19	03.08.19
012900	Payment Procedures	03.08.19	03.08.19
013100	Project Management and Coordination	03.08.19	03.08.19
013200	Construction Progress Documentation	03.08.19	03.08.19
013300	Submittal Procedures	03.08.19	03.08.19
014000	Quality Requirements	03.08.19	03.08.19
014200	References	03.08.19	03.08.19
014529	Testing and Laboratory Services	03.08.19	03.08.19
015000	Temporary Facilities and Controls	03.08.19	03.08.19
016000	Product Requirements	03.08.19	03.08.19
DIVISION 1 – GENERAL REQUIREMENTS - continued			
017300	Execution	03.08.19	03.08.19
017419	Construction Waste Management & Disposal	03.08.19	03.08.19

		CURRENT ISSUE <u>DATE</u>	ORIGINAL ISSUE <u>DATE</u>
017700	Closeout Procedures	03.08.19	03.08.19
017823	Operation and Maintenance Data	03.08.19	03.08.19
017839	Project Record Documents	03.08.19	03.08.19
017900	Demonstration and Training	03.08.19	03.08.19
DIVISION 2 – EXISTING CONDITIONS			
024116	Structure Demolition	03.08.19	03.08.19
DIVISION 3 – CONCRETE			
033000	Cast-in-Place Concrete	03.08.19	03.08.19
033523	Decorative Polished Concrete Finishes	03.08.19	03.08.19
DIVISION 4 – MASONRY – Not Used			
DIVISION 5 - METALS			
054000	Cold-Formed Metal Framing	03.08.19	03.08.19
055000	Metal Fabrications	03.08.19	03.08.19
057500	Decorative Formed Metal	By Addendum #1	
DIVISION 6 – WOOD AND PLASTICS			
061000	Rough Carpentry	03.08.19	03.08.19
061063	Exterior Rough Carpentry	03.08.19	03.08.19
061600	Sheathing	03.08.19	03.08.19
064023	Interior Architectural Woodwork	03.08.19	03.08.19
066400	Plastic Paneling	03.08.19	03.08.19
DIVISION 7 - THERMAL AND MOISTURE PROTECTION			
071113	Bituminous Dampproofing	03.08.19	03.08.19
072100	Thermal Insulation	03.08.19	03.08.19
072500	Weather Barriers	03.08.19	03.08.19
074213	Formed Metal Wall Panels	03.08.19	03.08.19
076200	Sheet Metal Flashing and Trim	03.08.19	03.08.19
077200	Roof Accessories	03.08.19	03.08.19
078413	Penetration Firestopping	03.08.19	03.08.19
078446	Fire-Resistive Joint Systems	03.08.19	03.08.19
079200	Joint Sealants	03.08.19	03.08.19
DIVISION 8 - DOORS AND WINDOWS			
081113	Hollow Metal Doors and Frames	03.08.19	03.08.19
081416	Flush Wood Doors	03.08.19	03.08.19
083113	Access Doors and Panels	03.08.19	03.08.19
084113	Aluminum Entrances and Storefronts	03.08.19	03.08.19
087100	Door Hardware	03.08.19	03.08.19
088000	Glazing	03.08.19	03.08.19
DIVISION 9 - FINISHES			
092116	Non-Structural Metal Framing	03.08.19	03.08.19
092900	Gypsum Board	03.08.19	03.08.19
093000	Tiling	03.08.19	03.08.19
095113	Acoustical Panel Ceilings	03.08.19	03.08.19
095433	Decorative Suspended Ceilings	03.08.19	03.08.19
096513	Resilient Base and Accessories	03.08.19	03.08.19

		CURRENT ISSUE DATE	ORIGINAL ISSUE DATE
096519	Resilient Tile Flooring	03.08.19	03.08.19
096723	Resinous Flooring	03.08.19	03.08.19
098436	Sound-Absorbing Ceiling Units	03.08.19	03.08.19
099113	Exterior Painting	03.08.19	03.08.19
099123	Interior Painting	03.08.19	03.08.19
099300	Staining and Transparent Finishing	03.08.19	03.08.19
099600	High-Performance Coatings	03.08.19	03.08.19
DIVISION 10 – SPECIALTIES			
101400	Signage	03.08.19	03.08.19
101423	ADA and Code Signage	03.08.19	03.08.19
102113	Toilet Compartments	03.08.19	03.08.19
102800	Toilet, Bath & Laundry Accessories	03.08.19	03.08.19
103100	Manufactured Fireplaces	03.08.19	03.08.19
104413	Fire Extinguisher Cabinets	03.08.19	03.08.19
104416	Fire Extinguishers	03.08.19	03.08.19
105113	Metal Lockers	03.08.19	03.08.19
DIVISION 11 – EQUIPMENT - Not Used			
DIVISION 12 - FURNISHINGS			
122413	Roller Window Shades	03.08.19	03.08.19
123200	Manufactured Wood Casework	03.08.19	03.08.19
124813	Entrance Floor Mats and Frames	03.08.19	03.08.19
DIVISION 13 - SPECIAL CONSTRUCTION			
133419	Metal Building Systems	03.08.19	03.08.19
DIVISION 21 – FIRE SUPPRESSION			
210500	Common Work Results for Fire Suppression	03.08.19	03.08.19
211100	Facility Fire-Suppression Water-Service Piping	03.08.19	03.08.19
211313	Wet-Pipe Sprinkler System	03.08.19	03.08.19
DIVISION 22 - PLUMBING			
220500	Common Work Results for Plumbing	03.08.19	03.08.19
220513	Common Motor Requirements for Plumbing Equipment	03.08.19	03.08.19
220516	Expansion Fittings and Loops for Plumbing Piping	03.08.19	03.08.19
220519	Meters and Gauges for Plumbing Piping	03.08.19	03.08.19
220523	General Duty Valves for Plumbing Piping	03.08.19	03.08.19
220529	Hangers and Supports for Plumbing Piping and Equipment	03.08.19	03.08.19
220553	Identification for Plumbing Piping and Equipment	03.08.19	03.08.19
220719	Plumbing Piping Identification	03.08.19	03.08.19
221116	Domestic Water Piping	03.08.19	03.08.19
221119	Domestic Water Piping Specialties	03.08.19	03.08.19
221316	Sanitary Waste and Vent Piping	03.08.19	03.08.19
221319	Sanitary Waste Piping Specialties	03.08.19	03.08.19
221323	Sanitary Waste Interceptors	03.08.19	03.08.19
224000	Plumbing Fixtures	03.08.19	03.08.19
224700	Drinking Fountains/Water Coolers	03.08.19	03.08.19
DIVISION 23 - HEATING, VENTILATING AND AIR CONDITIONING			
230500	Common Work Results for HVAC	03.08.19	03.08.19
230529	Hangers and Supports – HVAC	03.08.19	03.08.19

		CURRENT ISSUE DATE	ORIGINAL ISSUE DATE
230553	HVAC System Identification	03.08.19	03.08.19
230593	Testing, Adjusting, and Balancing	03.08.19	03.08.19
230529	Hangers and Supports – HVAC	03.08.19	03.08.19
230553	HVAC System Identification	03.08.19	03.08.19
230593	Testing, Adjusting, and Balancing	03.08.19	03.08.19
230713	Duct Insulation	03.08.19	03.08.19
230719	HVAC Piping Insulation	03.08.19	03.08.19
230900	Instrumentation and Control for HVAC	03.08.19	03.08.19
231123	Facility Natural-Gas Piping	03.08.19	03.08.19
232113	Hydronic Piping	03.08.19	03.08.19
232300	Refrigerant Piping	03.08.19	03.08.19
233113	Metal Ducts	03.08.19	03.08.19
233300	Duct Accessories	03.08.19	03.08.19
233416	Centrifugal HVAC Fans	03.08.19	03.08.19
233713	Diffusers, Registers, and Grilles	03.08.19	03.08.19
237413	Packaged, Outdoor, Central-Station Air-Handling Units	03.08.19	03.08.19
237423.13	Packaged, Outdoor, Heating-Only Makeup-Air Units	03.08.19	03.08.19

DIVISION 26 - ELECTRICAL

260500	Common Work Results for Electrical	03.08.19	03.08.19
260519	Low-Voltage Electrical Power Conductors and Cables	03.08.19	03.08.19
260526	Grounding and Bonding for Electrical Systems	03.08.19	03.08.19
260529	Hangers and Supports for Electrical Systems	03.08.19	03.08.19
260533	Raceway and Boxes for Electrical Systems	03.08.19	03.08.19
260544	Sleeves and Sleeve Seals for Electrical Raceways And Cabling	03.08.19	03.08.19
260553	Identification for Electrical Systems	03.08.19	03.08.19
260923	Lighting Control Devices	03.08.19	03.08.19
260943	Relay-Based Lighting Controls	03.08.19	03.08.19
262413	Switchboards	03.08.19	03.08.19
262416	Panelboards	03.08.19	03.08.19
262726	Wiring Devices	03.08.19	03.08.19
262813	Fuses	03.08.19	03.08.19
262816	Enclosed Switches and Circuit Breakers	03.08.19	03.08.19
265119	LED Interior Lighting	03.08.19	03.08.19
265219	Emergency and Exit Lighting	03.08.19	03.08.19
265219	LED Exterior Lighting	03.08.19	03.08.19

DIVISION 27 – COMMUNICATIONS

270500	Common Work Results for Communications	03.08.19	03.08.19
270526	Grounding and Bonding for Communications Systems	03.08.19	03.08.19
270528	Pathways for Communications System	03.08.19	03.08.19
271100	Communications Equipment Room Fittings	03.08.19	03.08.19

DIVISION 28 - ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION

283111	Digital, Addressable Fire-Alarm System	03.08.19	03.08.19
--------	----------------------------------------	----------	----------

DIVISION 31 - EARTHWORK

311000	Site Clearing	03.08.19	03.08.19
312000	Earth Moving	03.08.19	03.08.19
313116	Termite Control	03.08.19	03.08.19
313200	Soil Stabilization	03.08.19	03.08.19

DIVISION 32 - EXTERIOR IMPROVEMENTS

		CURRENT ISSUE <u>DATE</u>	ORIGINAL ISSUE <u>DATE</u>
321216	Asphalt Paving	03.08.19	03.08.19
321313	Concrete Paving	03.08.19	03.08.19
321373	Concrete Paving Joint Sealants	03.08.19	03.08.19
DIVISION 33 - UTILITIES			
331100	Water Utility Distribution Piping	03.08.19	03.08.19
333100	Sanitary Utility Sewerage Piping	03.08.19	03.08.19
334100	Storm Utility Drainage Piping	03.08.19	03.08.19

END OF TABLE OF CONTENTS

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Concrete bases.
 - 7. Supports and anchorages.

1.2 DEFINITIONS

- A. **Finished Spaces:** Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. **Exposed, Interior Installations:** Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. **Exposed, Exterior Installations:** Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. **Concealed, Interior Installations:** Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. **Concealed, Exterior Installations:** Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. **Steel Support Welding:** Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. **Steel Pipe Welding:** Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. **Electrical Characteristics for Fire-Suppression Equipment:** Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 COORDINATION

- A. Coordinate layout and installation with all other trades. Refer to section 230500 'Common Work Results for HVAC', paragraphs 1.3 and 1.4 for specific requirements regarding coordination procedures required.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM 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 stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping 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. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
 - Q. Verify final equipment locations for roughing-in.
 - R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.3 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 1. Construct concrete bases a minimum of 4 inches and a maximum of 6 inches deep, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.6 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 210500

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through wall or floor into the building.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- C. Related Sections:
 - 1. Division 21 Section "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
 - 2. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
 - 2. Comply with standards of authorities having jurisdiction for 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with the "Approval Guide," published by FM Global, 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-suppression water-service piping.

1.4 COORDINATION

- A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
- B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
- C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.

- D. Grooved-End, Ductile-Iron Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Star Pipe Products.
 - c. Victaulic Company.
 - d. Pre-approved equal.
 - 2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 - 3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- E. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.
 - 1. Gaskets: AWWA C111, rubber.
- G. Flanges: ASME B16.1, Class 125, cast iron.

2.2 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Flexible Expansion Joints:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron, Inc.
 - b. Hays Fluid Controls; a division of ROMAC Industries Inc.
 - c. Star Pipe Products.
 - d. Pre-approved equal.
 - 2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 3. Pressure Rating: 250 psig minimum.

2.3 ENCASUREMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear low-density PE film of 0.008-inch or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

2.4 JOINING MATERIALS

- A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

2.5 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
 - d. Hays Fluid Controls; a division of ROMAC Industries Inc.

- e. JCM Industries.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.
 - h. Pre-approved equal.
2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
 3. Standard: AWWA C219.
 4. Center-Sleeve Material: Manufacturer's standard, carbon steel, stainless steel, ductile iron, or malleable iron.
 5. Gasket Material: Natural or synthetic rubber.
 6. Pressure Rating: 200 psig minimum.
 7. Metal Component Finish: Corrosion-resistant coating or material.

2.6 GATE VALVES

A. AWWA Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. East Jordan Iron Works, Inc.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. NIBCO INC.
 - h. Tyler Pipe; a division of McWane, Inc.; Utilities Division.
 - i. U.S. Pipe.
 - j. Pre-approved equal.
2. 200-psig, AWWA, Iron, Nonrising-Stem, Metal-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
 - b. Standard: AWWA C500.
 - c. Pressure Rating: 200 psig.
 - d. End Connections: Mechanical joint.
 - e. Interior Coating: Complying with AWWA C550.
3. 200-psig, AWWA, Iron, 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.
 - b. Standard: AWWA C509.
 - c. Pressure Rating: 200 psig.
 - d. End Connections: Mechanical or push-on joint.
 - e. Interior Coating: Complying with AWWA C550.
4. 200-psig, AWWA, Iron, OS&Y, Metal-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet; with cast-iron double disc, bronze disc and seat rings, and bronze stem.
 - b. Standard: AWWA C500.
 - c. Pressure Rating: 200 psig.
 - d. End Connections: Flanged or grooved.
5. 200-psig, AWWA, Iron, OS&Y, Resilient-Seated Gate Valves:
 - a. Description: Cast- or ductile-iron body and bonnet; with bronze, gray-iron, or ductile-iron gate; resilient seats; and bronze stem.
 - b. Standard: AWWA C509.
 - c. Pressure Rating: 200 psig.
 - d. End Connections: Flanged or grooved.
6. Class 125, Bronze, Nonrising-Stem Gate Valves:
 - a. Description: Class 125, Type 1; bronze with solid wedge and malleable-iron handwheel.
 - b. Standard: MSS SP-80.
 - c. Pressure Rating: 200 psig.
 - d. End Connections: Solder joint or threaded.

B. UL-Listed or FM-Approved Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.

- d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. East Jordan Iron Works, Inc.
 - f. Kennedy Valve; a division of McWane, Inc.
 - g. Milwaukee Valve Company.
 - h. Mueller Co.; Water Products Division.
 - i. NIBCO INC.
 - j. Tyco Fire & Building Products LP.
 - k. United Brass Works, Inc.
 - l. U.S. Pipe.
 - m. Watts Water Technologies, Inc.
 - n. Pre-approved equal.
2. 175-psig, UL-Listed or FM-Approved, Iron, Nonrising-Stem Gate Valves:
 - a. Description: Iron body and bonnet, bronze seating material, and inside screw.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 175 psig minimum.
 - d. End Connections: Mechanical or push-on joint.
 - e. Indicator-Post Flange: Include on valves used with indicator posts.
 3. 175-psig, UL-Listed or FM-Approved, Iron, OS&Y, Gate Valves:
 - a. Description: Iron body and bonnet and bronze seating material.
 - b. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - c. Pressure Rating: 175 psig minimum.
 - d. End Connections: Flanged or grooved.
 4. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Crane Co.; Crane Valve Group; Stockham Division.
 - 3) Milwaukee Valve Company.
 - 4) NIBCO INC.
 - 5) United Brass Works, Inc.
 - 6) Pre-approved equal.
 - b. Description: Bronze body and bonnet and bronze stem.
 - c. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
 - d. Pressure Rating: 175 psig minimum.
 - e. End Connections: Threaded.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. East Jordan Iron Works, Inc.
 - d. Flowserve.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division.
 - g. U.S. Pipe.
 - h. Pre-approved equal.
 2. Description: Sleeve and valve compatible with drilling machine.
 3. Standard: MSS SP-60.
 4. Tapping Sleeve: Cast-iron, ductile-iron, or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Sleeve shall match size and type of pipe material being tapped and have recessed flange for branch valve.
 5. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised-face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 1. Operating Wrenches: Steel; with tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.8 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857, and made according to ASTM C 858.
- B. Ladder: ASTM A 36/A 36M, steel ladder; or PE-encased steel steps.
- C. Manhole: ASTM A 48/A 48M, Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
 - 1. Dimension: 24-inch minimum diameter unless otherwise indicated.
- D. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
 - 1. Dimension: 24-inch minimum diameter unless otherwise indicated.
- E. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

2.9 CHECK VALVES

- A. AWWA Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American AVK Company; Valves & Fittings Division.
 - b. American Cast Iron Pipe Company; American Flow Control Division.
 - c. APCO Willamette Valve and Primer Corporation.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Kennedy Valve; a division of McWane, Inc.
 - h. M&H Valve Company; a division of McWane, Inc.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Watts Water Technologies, Inc.
 - l. Pre-approved equal.
 - 2. Description: Swing-check type with resilient seat; with interior coating according to AWWA C550 and ends to match piping.
 - 3. Standard: AWWA C508.
 - 4. Pressure Rating: 175 psig.
- B. UL-Listed or FM-Approved Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Clow Valve Company; a division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Globe Fire Sprinkler Corporation.
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Kidde Fire Fighting.
 - g. Matco-Norca.
 - h. Mueller Co.; Water Products Division.
 - i. NIBCO INC.
 - j. Reliable Automatic Sprinkler Co., Inc.
 - k. Tyco Fire & Building Products LP.
 - l. United Brass Works, Inc.
 - m. Victaulic Company.
 - n. Viking Corporation.
 - o. Watts Water Technologies, Inc.
 - p. Pre-approved equal.
 - 2. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
 - 3. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
 - 4. Pressure Rating: 175 psig.

2.10 BACKFLOW PREVENTERS

- A. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
 - g. Pre-approved equal.
2. Standard: ASSE 1015 or AWWA C510.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
5. Body Material: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow unless vertical required due to space limitations.
8. Accessories: Ball valves with threaded ends on inlet and outlet of NPS 2 and smaller; OS&Y gate valves with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

2.11 FIRE-DEPARTMENT CONNECTIONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Elkhart Brass Mfg. Company, Inc.
 2. Fire-End & Croker Corporation.
 3. Guardian Fire Equipment, Inc.
 4. Kidde Fire Fighting.
 5. Potter Roemer.
 6. Reliable Automatic Sprinkler Co., Inc.
 7. Pre-approved equal.
- B. Standard: UL 405.
- C. Connections: 5" Storz.
- D. Inlet Alignment: Inline, horizontal.
- E. Finish Including Sleeve: Polished chrome plated.
- F. Escutcheon Plate Marking: "FIRE DEPARTMENT CONNECTION."

2.12 ALARM DEVICES

- A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.
- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

2.13 SLEEVES

- A. Cast-Iron Wall-Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard-weight, zinc-coated, plain ends.

2.14 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Pre-approved equal.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- C. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- D. Pressure Plates: Carbon steel, plastic, or stainless steel.
- E. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements.

2.15 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. Comply with NFPA 24 for fire-service-main piping materials and installation.
- B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- C. Bury piping with depth of cover over top at least 30 inches, with top at least 12 inches below level of maximum frost penetration.
- D. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.
 - 1. Terminate fire-suppression water-service piping at building floor slab or wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.
- E. 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.
- F. Comply with requirements in Division 21 Sections for fire-suppression-water piping inside the building.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
- F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- G. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.
- H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.
- I. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.4 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 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. UL-Listed or FM-Approved 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.
- C. MSS Valves: Install as component of connected piping system.
- D. Support valves and piping, not direct buried, on concrete piers. Comply with requirements for concrete piers in Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

3.6 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.

3.7 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

3.8 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire-department connection to mains.

3.9 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
 - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
 - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
 - 1. Valves: Install chain and padlock on open OS&Y gate valve.
 - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building's fire-alarm system. Wiring and fire-alarm devices are specified in Division 28 Sections.

3.10 CONNECTIONS

- A. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in exterior walls.
 - 1. Exception: Sleeves are not required for core-drilled holes.
- B. Cut sleeves to length for mounting flush with both surfaces.
- C. Install sleeves in new floor slabs and walls as they are constructed.
- D. For exterior wall penetrations above grade, seal annular space between sleeves and piping using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants;" or use sleeve seals.
- E. For exterior wall penetrations below grade, seal annular space between sleeves and piping using sleeve seals.
- F. Seal space outside of sleeves in concrete walls with grout.
- G. Install the following sleeve materials:
 - 1. Galvanized-steel pipe sleeves for pipes smaller than NPS 6.
 - 2. Cast-iron wall-pipe or galvanized-steel pipe sleeves for pipes NPS 6.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete floor slabs and walls at fire-suppression water-service piping entries into the building.

- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.13 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
 - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare test and inspection reports.

3.14 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.15 CLEANING

- A. Clean and disinfect fire-suppression water-service piping as follows:
 - 1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

3.16 PIPING SCHEDULE

- A. Underground and underslab fire-suppression water-service piping NPS 8 and smaller shall be one of the following:
 - 1. Grooved-end, ductile-iron pipe; grooved-end, ductile-iron pipe appurtenances; and grooved joints.
 - 2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
 - 3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.

3.17 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
- B. Underground fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:
 - 1. 200-psig, AWWA, iron, nonrising-stem, resilient-seated gate valves.
 - 2. 175-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves.
- C. Indicator-post underground fire-suppression water-service valves NPS 3 and larger shall be 175-psig, UL-listed or FM-approved, iron, nonrising-stem gate valves with indicator-post flange.
- D. Standard-pressure, vault fire-suppression water-service shutoff valves NPS 3 and larger shall be one of the following:
 - 1. 200-psig, AWWA, iron, OS&Y, resilient-seated gate valves.
 - 2. 175-psig, UL-listed or FM-approved, iron, OS&Y gate valves.

END OF SECTION 211100

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Fire-department connections.
 - 4. Sprinklers.
 - 5. Excess-pressure pumps.
 - 6. Alarm devices.
 - 7. Pressure gages.

- B. Related Sections:
 - 1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.

1.2 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

- B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

- B. Delegated Design: Design sprinkler system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Waterloop is not complete in this area so fire-hydrant flow test records are not available. Utility has provided that the following minimum flow and pressure will be provided to the building:
 - a. Flow: 500 gpm.
 - b. Pressure: 65 psig.
 - 2. Upon completion of the water loop, engage utility for a flow test to confirm pressures and flows.

- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - c. General Storage Areas: Ordinary Hazard, Group 1.
 - d. Laundries: Ordinary Hazard, Group 1.
 - e. Libraries except Stack Areas: Light Hazard.
 - f. Library Stack Areas: Ordinary Hazard, Group 2.
 - g. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - h. Office and Public Areas: Light Hazard.
 - i. Repair Garages: Ordinary Hazard, Group 2.
 - j. Restaurant Service Areas: Ordinary Hazard, Group 1.
 - k. Solvent Cleaning Areas: Extra Hazard, Group 2.
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
 - 4. Maximum Protection Area per Sprinkler: Per UL listing.
 - 5. Maximum Protection Area per Sprinkler:

- a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Qualification Data: For qualified Installer and professional engineer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Welding certificates.
- G. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- H. Field quality-control reports.
- I. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 30, Galvanized- and Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Thinwall Galvanized- and Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- D. Galvanized and Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized and uncoated, Steel Couplings: ASTM A 865, threaded.
- F. Galvanized and uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- K. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Pre-approved equal.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.
 - 2. Minimum Pressure Rating: 175 psig.
- B. Check Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. Anvil International, Inc.

- c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Fire-End & Croker Corporation.
 - h. Fire Protection Products, Inc.
 - i. Globe Fire Sprinkler Corporation.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Metraflex, Inc.
 - l. Milwaukee Valve Company.
 - m. Mueller Co.; Water Products Division.
 - n. NIBCO INC.
 - o. Potter Roemer.
 - p. Reliable Automatic Sprinkler Co., Inc.
 - q. Tyco Fire & Building Products LP.
 - r. United Brass Works, Inc.
 - s. Venus Fire Protection Ltd.
 - t. Victaulic Company.
 - u. Viking Corporation.
 - v. Watts Water Technologies, Inc.
 - w. Pre-approved equal.
- 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig minimum
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
 - f. Pre-approved equal.
- 2. Standard: UL 262.
- 3. Pressure Rating: 175 psig.
- 4. Body Material: Bronze.
- 5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Tyco Fire & Building Products LP.
 - l. United Brass Works, Inc.
 - m. Watts Water Technologies, Inc.
 - n. Pre-approved equal.
- 2. Standard: UL 262.
- 3. Pressure Rating: 250 psig minimum
- 4. Body Material: Cast or ductile iron.
- 5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.

- b. Global Safety Products, Inc.
 - c. Kennedy Valve; a division of McWane, Inc.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Tyco Fire & Building Products LP.
 - g. Victaulic Company.
 - h. Pre-approved equal.
- 2. Standard: UL 1091.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 - 5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 - 6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch or electrical, 115-V ac, prewired, two-circuit, supervisory switch and visual indicating device.

2.5 TRIM AND DRAIN VALVES

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Minimum Pressure Rating: 175 psig.
- B. Ball Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. Flowserve.
 - f. Kennedy Valve; a division of McWane, Inc.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Potter Roemer.
 - j. Red-White Valve Corporation.
 - k. Tyco Fire & Building Products LP.
 - l. Victaulic Company.
 - m. Watts Water Technologies, Inc.
 - n. Pre-approved equal.

2.6 SPECIALTY VALVES

- A. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body Material: Cast or ductile iron.
 - 4. Size: Same as connected piping.
 - 5. End Connections: Flanged or grooved.
- B. Alarm Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 - f. Pre-approved equal.
 - 2. Standard: UL 193.
 - 3. Design: For horizontal or vertical installation.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Pre-approved equal.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Pre-approved equal.
2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Pre-approved equal.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
 - d. Pre-approved equal.
2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
 - f. Pre-approved equal.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 3. Pressure Rating: 175 psig minimum.
 4. Body Material: Cast- or ductile-iron housing with sight glass.
 5. Size: Same as connected piping.
 6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
 - d. Pre-approved equal.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. Pre-approved equal.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Venus Fire Protection Ltd.
5. Victaulic Company.
6. Viking Corporation.
7. Pre-approved equal.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Nonresidential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.

2. Bronze.
 3. Painted.
- E. Special Coatings:
1. Wax.
 2. Lead.
 3. Corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- G. Sprinkler Guards:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - e. Pre-approved equal.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Water-Motor-Operated Alarm:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - e. Pre-approved equal.
 2. Standard: UL 753.
 3. Type: Mechanically operated, with Pelton wheel.
 4. Alarm Gong: Cast aluminum with red-enamel factory finish.
 5. Size: 10-inch diameter.
 6. Components: Shaft length, bearings, and sleeve to suit wall construction.
 7. Inlet: NPS 3/4.
 8. Outlet: NPS 1 drain connection.
- C. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 - g. Pre-approved equal.
 2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 5. Type: Paddle operated.
 6. Pressure Rating: 250 psig.
 7. Design Installation: Horizontal or vertical.
- D. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.

- b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Pre-approved equal.
- 2. Standard: UL 346.
 - 3. Type: Electrically supervised.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design: Signals that controlled valve is in other than fully open position.

2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
 - 5. Pre-approved equal.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

2.11 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.12 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set-screws.

2.13 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Pre-approved equal.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel, plastic, or stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements.

2.14 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Division 21 Section "Facility Fire-Suppression Water-Service Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.
- N. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

- L. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.6 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 5. Bare Piping in Equipment Rooms: One piece, cast brass or stamped steel with set-screw.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.7 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.8 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.9 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Standard-weight, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
4. Standard-weight, galvanized-steel pipe with plain ends; galvanized, plain-end-pipe fittings; and twist-locked joints.
5. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
7. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:

1. Standard-weight or Schedule 30, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Standard-weight or Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.
4. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
5. Thinwall black-steel pipe with plain ends; welding fittings; and welded joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. All Gypboard Ceilings and/or Soffits: Concealed head sprinklers - custom color by Architect.
2. Auditorium 'House' ceiling system: Concealed head sprinklers - custom color by Architect.
3. Locate sprinkler heads per detail on Drawings.
4. Stage: provide manufacturer provided cage around each sprinkler head.
5. Stage Craft: provide manufacturer provided cage around each sprinkler head.
6. Gyms: provide manufacturer provided cage around each sprinkler head.
7. Wrestling Room: provide manufacturer provided cage around each sprinkler head.
8. Weight Room: provide manufacturer provided cage around each sprinkler head.
9. Locker Rooms: provide manufacturer provided cage around each sprinkler head.
10. Rooms without Ceilings: Upright sprinklers.
11. Rooms with Suspended Ceilings: Pendent sprinklers.
12. Wall Mounting: Sidewall sprinklers.

13. Spaces Subject to Freezing: Pendent, dry sprinklers.
 14. Deluge-Sprinkler Systems: pendent, open sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with custom color plate.
 2. Recessed Sprinklers: Bright chrome, with chrome escutcheon.
 3. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Piping materials and installation instructions common to most piping systems.
 2. Transition fittings.
 3. Dielectric fittings.
 4. Mechanical sleeve seals.
 5. Sleeves.
 6. Escutcheons.
 7. Grout.
 8. Plumbing demolition.
 9. Equipment installation requirements common to equipment sections.
 10. Painting and finishing.
 11. Concrete bases.
 12. Supports and anchorages.

1.3 DEFINITIONS

- A. **Finished Spaces:** Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. **Exposed, Interior Installations:** Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. **Exposed, Exterior Installations:** Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. **Concealed, Interior Installations:** Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. **Concealed, Exterior Installations:** Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 1. **ABS:** Acrylonitrile-butadiene-styrene plastic.
 2. **CPVC:** Chlorinated polyvinyl chloride plastic.
 3. **PE:** Polyethylene plastic.
 4. **PVC:** Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 1. **EPDM:** Ethylene-propylene-diene terpolymer rubber.
 2. **NBR:** Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. **Product Data:** For the following:
 1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.

- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Coordinate layout and installation with all other trades. Refer to section 230500 'Common Work Results for HVAC', paragraphs 1.3 and 1.4 for specific requirements regarding coordination procedures required.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- D. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

- b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BA91, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - g. Pre-approved equal.
 - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eslon Thermoplastics.
 - b. Pre-approved equal.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thompson Plastics, Inc.
 - b. Pre-approved equal.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
 - c. Pre-approved equal.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Cascade Waterworks Mfg. Co.
- b. Fernco, Inc.
- c. Mission Rubber Company.
- d. Plastic Oddities, Inc.
- e. Pre-approved equal.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 - h. Pre-approved equal.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Pre-approved equal.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Pre-approved equal.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - c. Pre-approved equal.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
 - e. Pre-approved equal.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Pre-approved equal.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Plastic, carbon steel, or stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping 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. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.3 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
 - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 1. Construct concrete bases a minimum of 4 inches and a maximum of 6 inches deep, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete" or "Miscellaneous Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.10 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 220500

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 1. Motor controllers.
 2. Torque, speed, and horsepower requirements of the load.
 3. Ratings and characteristics of supply circuit and required control sequence.
 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 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. Flexible-hose packless expansion joints.
 2. Metal-bellows packless expansion joints.
 3. Rubber packless expansion joints.
 4. Grooved-joint expansion joints.
 5. Pipe loops and swing connections.
 6. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product Certificates: For each type of expansion joint, from manufacturer.
- E. Maintenance Data: For expansion joints to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.

- c. Flex Pression Ltd.
 - d. Metraflex, Inc.
 - e. Unisource Manufacturing, Inc.
 - f. Pre-approved equal.
2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
 4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
 6. Expansion Joints for Steel Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
 7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Stainless-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
 8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Stainless-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.
- B. Metal-Bellows Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adscoc Manufacturing LLC.
 - b. American BOA, Inc.
 - c. Badger Industries, Inc.
 - d. Expansion Joint Systems, Inc.
 - e. Flex-Hose Co., Inc.
 - f. Flexicraft Industries.
 - g. Flex Pression Ltd.
 - h. Flex-Weld, Inc.
 - i. Flo Fab inc.
 - j. Hyspan Precision Products, Inc.
 - k. Metraflex, Inc.
 - l. Proco Products, Inc.
 - m. Senior Flexonics Pathway.
 - n. Tozen Corporation.
 - o. Unaflex.
 - p. Unisource Manufacturing, Inc.
 - q. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.
 - r. U.S. Bellows, Inc.
 - s. WahlcoMetroflex.
 - t. Pre-approved equal.
 2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 3. Type: Circular, corrugated bellows with external tie rods.
 4. Minimum Pressure Rating: 150 psig unless otherwise indicated.
 5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
 6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint.

- b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint.
 - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.
- C. Rubber Packless Expansion Joints:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
 - b. Mason Industries, Inc.; Mercer Rubber Co.
 - c. Metraflex, Inc.
 - d. Pre-approved equal.
 - 2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 - 3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
 - 4. Arch Type: multiple arches with external control rods.
 - 5. Spherical Type: multiple spheres with external control rods.
 - 6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
 - 7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200 deg F.
 - 8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
 - 9. Material for Water: EPDM.
 - 10. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.2 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adscoc Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Senior Flexonics Pathway.
 - i. Unisource Manufacturing, Inc.
 - j. U.S. Bellows, Inc.
 - k. Pre-approved equal.
 - 2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.
- B. Anchor Materials:
- 1. Steel Shapes and Plates: ASTM A 36/A 36M.
 - 2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
 - 3. Washers: ASTM F 844, steel, plain, flat washers.
 - 4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
 - 5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-NMEJ-702.

D. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one or two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Bimetallic-actuated thermometers.
 2. Filled-system thermometers.
 3. Liquid-in-glass thermometers.
 4. Light-activated thermometers.
 5. Thermowells.
 6. Dial-type pressure gages.
 7. Gage attachments.
 8. Test plugs.
 9. Test-plug kits.
 10. Sight flow indicators.
- B. Related Sections:
 1. Division 21 Section "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
 2. Division 21 fire-suppression piping Sections for fire-protection pressure gages.
 3. Division 22 Section "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
 4. Division 22 Section "Domestic Water Piping" for water meters inside the building.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of meter and gage, from manufacturer.
- C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Trerice, H. O. Co.
 2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 3. Weiss Instruments, Inc.
 4. Pre-approved equal.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

- H. Window: Plain glass or plastic.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

- A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Trelice, H. O. Co.
 - g. Weiss Instruments, Inc.
 - h. Pre-approved equal.
 - 2. Standard: ASME B40.200.
 - 3. Case: Sealed type, cast aluminum or drawn steel; 6-inch nominal diameter.
 - 4. Element: Bourdon tube or other type of pressure element.
 - 5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
 - 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Pointer: Dark-colored metal.
 - 8. Window: Glass.
 - 9. Ring: Stainless steel.
 - 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
 - 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 12. Accuracy: Plus or minus 1 percent of scale range.
- B. Direct-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Miljoco Corporation.
 - c. REOTEMP Instrument Corporation.
 - d. Pre-approved equal.
 - 2. Standard: ASME B40.200.
 - 3. Case: Sealed type, plastic; 4-1/2-inch nominal diameter.
 - 4. Element: Bourdon tube or other type of pressure element.
 - 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 - 7. Pointer: Dark-colored metal.
 - 8. Window: Glass.
 - 9. Ring: Metal or plastic.
 - 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
 - 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 12. Accuracy: Plus or minus 1 percent of scale range.
- C. Remote-Mounted, Metal-Case, Vapor-Actuated Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Marsh Bellofram.

- d. Miljoco Corporation.
 - e. Palmer Wahl Instrumentation Group.
 - f. REOTEMP Instrument Corporation.
 - g. Trerice, H. O. Co.
 - h. Weiss Instruments, Inc.
 - i. WIKA Instrument Corporation - USA.
 - j. Pre-approved equal.
2. Standard: ASME B40.200.
 3. Case: Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
 4. Element: Bourdon tube or other type of pressure element.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 7. Pointer: Dark-colored metal.
 8. Window: Glass.
 9. Ring: Stainless steel.
 10. Connector Type(s): Union joint, bottom; with ASME B1.1 screw threads.
 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 12. Accuracy: Plus or minus 1 percent of scale range.
- D. Remote-Mounted, Plastic-Case, Vapor-Actuated Thermometers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Miljoco Corporation.
 - d. REOTEMP Instrument Corporation.
 - e. Trerice, H. O. Co.
 - f. Pre-approved equal.
 2. Standard: ASME B40.200.
 3. Case: Sealed type, plastic; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
 4. Element: Bourdon tube or other type of pressure element.
 5. Movement: Mechanical, with link to pressure element and connection to pointer.
 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
 7. Pointer: Dark-colored metal.
 8. Window: Glass.
 9. Ring: Metal or plastic.
 10. Connector Type(s): Union joint, threaded, bottom; with ASME B1.1 screw threads.
 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 12. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

- A. Thermowells:
1. Standard: ASME B40.200.
 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 3. Material for Use with Copper Tubing: CNR or CUNI.
 4. Material for Use with Steel Piping: CRES or CSA.
 5. Type: Stepped shank unless straight or tapered shank is indicated.
 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
 8. Bore: Diameter required to match thermometer bulb or stem.
 9. Insertion Length: Length required to match thermometer bulb or stem.
 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Trelice, H. O. Co.
 - b. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - c. Weiss Instruments, Inc.
 - d. Pre-approved equal.
2. Standard: ASME B40.100.
3. Case: Liquid-filled, sealed, open-front, pressure relief, solid-front, pressure relief type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass or stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Flo Fab Inc.
 - d. Marsh Bellofram.
 - e. Miljoco Corporation.
 - f. Noshok.
 - g. Palmer Wahl Instrumentation Group.
 - h. REOTEMP Instrument Corporation.
 - i. Tel-Tru Manufacturing Company.
 - j. Trelice, H. O. Co.
 - k. Weiss Instruments, Inc.
 - l. WIKA Instrument Corporation - USA.
 - m. Winters Instruments - U.S.
 - n. Pre-approved equal.
2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Trelice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.

- o. Winters Instruments - U.S.
- p. Pre-approved equal.
- 2. Standard: ASME B40.100.
- 3. Case: Liquid-filled, sealed type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Ring: Stainless steel.
- 11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Miljoco Corporation.
 - d. Noshok.
 - e. Palmer Wahl Instrumentation Group.
 - f. REOTEMP Instrument Corporation.
 - g. Tel-Tru Manufacturing Company.
 - h. Trerice, H. O. Co.
 - i. Weiss Instruments, Inc.
 - j. WIKA Instrument Corporation - USA.
 - k. Winters Instruments - U.S.
 - l. Pre-approved equal.
- 2. Standard: ASME B40.100.
- 3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
- 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 6. Movement: Mechanical, with link to pressure element and connection to pointer.
- 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 8. Pointer: Dark-colored metal.
- 9. Window: Glass.
- 10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
 - 9. Pre-approved equal.
- B. Description: Test-station fitting made for insertion into piping tee fitting.

- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Trerice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
 9. Pre-approved equal.
- B. Furnish one test-plug kit containing two thermometers, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.8 SIGHT FLOW INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Archon Industries, Inc.
 2. Dwyer Instruments, Inc.
 3. Emerson Process Management; Brooks Instrument.
 4. Ernst Co., John C., Inc.
 5. Ernst Flow Industries.
 6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
 7. OPW Engineered Systems; a Dover company.
 8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
 9. Pre-approved equal.
- B. Description: Piping inline-installation device for visual verification of flow.
- C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- D. Minimum Pressure Rating: 150 psig.
- E. Minimum Temperature Rating: 200 deg F.
- F. End Connections for NPS 2 and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Direct-mounted, metal- or plastic-case, vapor-actuated type.
 - 3. Test plug with EPDM self-sealing rubber inserts.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Direct-mounted, metal- or plastic-case, vapor-actuated type.
 - 3. Test plug with EPDM self-sealing rubber inserts.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.

2. Direct-mounted, metal or plastic-case, vapor-actuated type.
3. Test plug with EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:

1. Sealed, bimetallic-actuated type.
2. Direct-mounted, metal or plastic-case, vapor-actuated type.
3. Test plug with EPDM self-sealing rubber inserts.

E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:

1. Sealed, direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.
3. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:

1. Sealed, direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.
3. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Sealed, direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.
3. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi.

B. Scale Range for Domestic Water Piping: 0 to 200 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Bronze angle valves.
 2. Bronze ball valves.
 3. Iron, single-flange butterfly valves.
 4. Iron, grooved-end butterfly valves.
 5. Bronze swing check valves.
 6. Iron swing check valves.
 7. Iron swing check valves with closure control.
 8. Iron, grooved-end swing check valves.
 9. Iron, center-guided check valves.
 10. Bronze gate valves.
 11. Bronze globe valves.
 12. Iron globe valves.
 13. Polypropylene valves.
- B. Related Sections:
 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 2. ASME B31.1 for power piping valves.
 3. ASME B31.9 for building services piping valves.

- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.

- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

- A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

- A. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kennedy Valve; a division of McWane, Inc.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire Products LP; Grinnell Mechanical Products.
 - d. Victaulic Company.

2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

2.6 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.7 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Composition.
 - g. Seat Ring: Bronze.
 - h. Disc Holder: Bronze.
 - i. Disc: PTFE or TFE.
 - j. Gasket: Asbestos free.

2.8 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.

2.9 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. APCO Willamette Valve and Primer Corporation.
 - c. Crispin Valve.
 - d. DFT Inc.
 - e. GA Industries, Inc.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Sure Flow Equipment Inc.
 - j. Val-Matic Valve & Manufacturing Corp.
 2. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron.
 - d. Style: Globe, spring loaded.
 - e. Ends: Flanged.
 - f. Seat: EPDM.

2.10 BRONZE GATE VALVES

- A. Class 125, RS Bronze Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.11 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.12 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. 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.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe, ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends. Solder joint ball valves allowed up to NPS 3.
 - 2. Bronze Angle Valves: Class 125, nonmetallic disc.
 - 3. Ball Valves: One piece, reduced port, bronze with bronze trim.
 - 4. Bronze Swing Check Valves: Class 125, nonmetallic disc.
 - 5. Bronze Gate Valves: Class 125, RS.
 - 6. Bronze Globe Valves: Class 125, nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
 - 3. Iron, Grooved-End Butterfly Valves: 175 CWP.
 - 4. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
 - 5. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
 - 6. Iron, Grooved-End Swing Check Valves: 300 CWP.
 - 7. Iron, Center-Guided Check Valves: Class 125, resilient seat.
 - 8. Iron Globe Valves: Class 125.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 1. Steel pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Fiberglass pipe hangers.
 4. Metal framing systems.
 5. Fiberglass strut systems.
 6. Thermal-hanger shield inserts.
 7. Fastener systems.
 8. Pipe stands.
 9. Pipe positioning systems.
 10. Equipment supports.
- B. Related Sections include the following:
 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
 3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 4. Division 22 Section "Vibration for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
 1. Steel pipe hangers and supports.
 2. Fiberglass pipe hangers.
 3. Thermal-hanger shield inserts.
 4. Powder-actuated fastener systems.
 5. Pipe positioning systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 1. Trapeze pipe hangers. Include Product Data for components.
 2. Metal framing systems. Include Product Data for components.
 3. Fiberglass strut systems. Include Product Data for components.
 4. Pipe stands. Include Product Data for components.
 5. Equipment supports.

- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code—Steel;" AWS D1.4, "Structural Welding Code--Reinforcing Steel;" and ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco Inc.
 - 15. Pre-approved equal.

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.

2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.
8. Pre-approved equal.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.
7. Pre-approved equal.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated or stainless steel, 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. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.
 - g. Pre-approved equal.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, 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 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. 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, NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, 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, NPS 3/4 to NPS 8.
 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 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, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, 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, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. 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.
- I. 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.
- J. 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.
- K. 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 absorb 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 absorb 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 absorb 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.

- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Fastener System Installation:
 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Stand Installation:
 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- 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, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- L. Load Distribution: Install hangers and supports so 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 so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- N. Insulated Piping: Comply with the following:
 - 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 according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. 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. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. 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 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. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.
 4. Stencils.
 5. Valve tags.
 6. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- 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.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 1. Material and Thickness: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Black.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-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. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch; stainless steel, 0.025-inch; aluminum, 0.032-inch; or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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. Valve-tag schedule shall be included in operation and maintenance data.
 - 2. Provide framed ready-to-hang water valve shut-off location directory.

2.5 WARNING TAGS

- A. Warning Tags: 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: Brass grommet and wire or reinforced grommet and wire or string.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

3.4 VALVE-TAG INSTALLATION

- 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.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches, round.
 - b. Hot Water: 2 inches, round.
 - 2. Valve-Tag Color:
 - a. Cold Water: Natural or green.
 - b. Hot Water: Natural or green.
 - 3. Letter Color:
 - a. Cold Water: Black or white.
 - b. Hot Water: Black or white.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 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).
- 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.
 - 3. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 4. Detail application of field-applied jackets and fitting covers.
- C. LEED Submittals:
 - 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
 - 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- 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.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on piping segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Plumbing Piping Insulation Schedule" for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000-Degree Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 - d. Pre-approved equal.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
- D. Flexible Elastomeric Insulation: Closed-cell, expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
 - d. Pre-approved equal.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. Pre-approved equal.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand; CP-50 AHV2.
 - b. Foster Brand; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d. Pre-approved equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Flexible Elastomeric Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-76.
 - b. Foster Brand; 30-45.
 - c. Pittsburgh Corning Corporation; Pittseal 444.
 - d. Pre-approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - e. Pre-approved equal.
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers.
 - 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.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI; 428 AWF ASJ.
 - b. Avery Dennison Corporation; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. Pre-approved equal.
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. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - d. Pre-approved equal.
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.

2.9 SECUREMENTS

A. Staples for Hot Service Only: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - b. Plumberex.
 - c. Truebro; a brand of IPS Corporation.
 - d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - e. Pre-approved equal.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply 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. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

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 thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, no penetrations of the insulation shall occur at hangers, supports, anchors, and other projections. Seal joints and seams with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.

3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 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.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services, 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.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Finish exposed surfaces with a PVC jacket.

3.6 INSTALLATION OF MINERAL-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 factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. 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.

3.8 FIELD QUALITY CONTROL

- #### A. All insulation applications will be considered defective Work if inspection reveals noncompliance with requirements.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Encasement for piping.
 - 3. Specialty valves.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Wall penetration systems.
- B. Related Section:
 - 1. Division 22 Section "Facility Water Distribution Piping" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.
- C. Reference Documents:
 - 1. ASTM F 2389-06 - Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.
 - 2. CSA B137.11 - Polypropylene (PP-R) Pipe and Fittings for Pressure Applications.
 - 3. NSF/ANSI 14 – Plastic Piping System Components and Related Materials.
 - 4. NSF/ANSI 61 – Drinking Water Systems Components – Health Effects.
- D. Definitions:
 - 1. Definitions shall be in accordance with local plumbing codes and ASTM F 2389.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Backflow preventers and vacuum breakers.
 - 6. Escutcheons.
 - 7. Sleeves and sleeve seals.
 - 8. Water penetration systems.
 - 9. Piping.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. Compressed air piping.
 - 4. HVAC hydronic piping.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF 61 for potable domestic water piping and components.
- C. Material shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
- D. Material shall comply with manufacturers specifications.
- E. Special Engineered products shall be certified by NSF International as complying with NSF 14.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 1. Notify Architect, Construction Manager, or Owner no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Architect's, Construction Manager's, or Owner's written permission.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 4. 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.
 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 4) Pre-approved equal.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 6. Copper-Tube Extruded-Tee Connections:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) T-DRILL Industries Inc.
 - 2) Pre-approved equal.
 - b. Description: Tee formed in copper tube according to ASTM F 2014.
 7. Grooved-Joint Copper-Tube Appurtenances:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - 4) Pre-approved equal.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
 2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.
 - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.
 - a. Gaskets: AWWA C111, rubber.
 2. Compact-Pattern, Push-on-Joint Fittings: AWWA C153, ductile iron.
 - a. Gaskets: AWWA C111, rubber.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASUREMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: Sheet or tube.
- C. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.
- D. Color: Black or natural.

2.6 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.7 TRANSITION FITTINGS

- A. General Requirements:
 1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.

- b. Dresser, Inc.; Dresser Piping Specialties.
- c. Ford Meter Box Company, Inc. (The).
- d. JCM Industries.
- e. Romac Industries, Inc.
- f. Smith-Blair, Inc; a Sensus company.
- g. Viking Johnson; c/o Mueller Co.
- h. Pre-approved equal.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - g. Pre-approved equal.
 - 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Pre-approved equal.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 175 psig minimum.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Pre-approved equal.
 - 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 - c. Pre-approved equal.
 - 2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

- F. Dielectric Nipples:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
 - d. Pre-approved equal.
 2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flex-Hose Co., Inc.
 2. Flexicraft Industries.
 3. Flex Pression, Ltd.
 4. Flex-Weld, Inc.
 5. Hyspan Precision Products, Inc.
 6. Mercer Rubber Co.
 7. Metraflex, Inc.
 8. Proco Products, Inc.
 9. Tozen Corporation.
 10. Unaflex, Inc.
 11. Universal Metal Hose; a Hyspan company.
 12. Pre-approved equal.
- 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 NPS 2) and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- 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 NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.10 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.12 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Pre-approved equal.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel or stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or stainless steel of length required to secure pressure plates to sealing elements.

2.13 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.

- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- H. Install domestic water piping level without pitch and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- M. Install piping adjacent to equipment and specialties to allow service and maintenance.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.
- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 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. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

- F. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- G. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- H. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.
- I. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

- B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2 and Smaller: 32 inches with 3/8-inch rod.
- G. Install hangers for vertical PEX piping every 48 inches
- H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PE, molded PVC, or steel pipe.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe or stack sleeve fittings.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 3. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE, molded PVC, or steel pipe.
 4. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
 5. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.14 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.15 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. 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:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - 2. 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.
 - 3. 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.
 - 4. 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 to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 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 for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.16 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 flow of hot water 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.

3.17 CLEANING

- A. Clean and disinfect potable and 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 and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- 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.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.18 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:
 1. Soft copper tube, ASTM B 88, Type K or ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
 1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern mechanical-joint fittings; and mechanical joints.
 2. Push-on-joint, ductile-iron pipe; standard- or compact-pattern push-on-joint fittings; and gasketed joints.
- F. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- H. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.

3.19 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 1. Vacuum breakers.
 2. Backflow preventers.
 3. Water pressure-reducing valves.
 4. Balancing valves.
 5. Temperature-actuated water mixing valves.
 6. Strainers.
 7. Outlet boxes.
 8. Hose bibbs.
 9. Wall hydrants.
 10. Drain valves.
 11. Water hammer arresters.
 12. Air vents.
- B. Related Sections include the following:
 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 2. Division 22 Section "Domestic Water Piping" for water meters.
 3. Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.
 4. Division 22 Section "Healthcare Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
 5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
 6. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:
 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - i. Pre-approved equal.
 2. Standard: ASSE 1001.
 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 4. Body: Bronze.
 5. Inlet and Outlet Connections: Threaded.
 6. Finish: Rough bronze or chrome plated where in public view.
- B. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
 - k. Pre-approved equal.
 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: Chrome or nickel plated or rough bronze where in public view.
- C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
 - h. Pre-approved equal.
 2. Standard: ASSE 1020.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.
- D. Laboratory-Faucet Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - e. Pre-approved equal.
 2. Standard: ASSE 1035.
 3. Size: NPS 1/4 or NPS 3/8 matching faucet size.

4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Pre-approved equal.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - e. Pre-approved equal.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Body: Bronze.
5. End Connections: Union, solder joint.
6. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - e. Pre-approved equal.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through; vertical inlet, horizontal center section, and vertical outlet; or vertical where space constraints require, flow.
8. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - e. Pre-approved equal.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:

- a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
- D. Beverage-Dispensing-Equipment Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 - d. Pre-approved equal.
 - 2. Standard: ASSE 1022.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: NPS 1/4 or NPS 3/8.
 - 5. Body: Stainless steel.
 - 6. End Connections: Threaded.
- E. Dual-Check-Valve Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - e. Pre-approved equal.
 - 2. Standard: ASSE 1024.
 - 3. Operation: Continuous-pressure applications.
 - 4. Body: Bronze with union inlet.
- F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Lancer Corporation.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Pre-approved equal.
 - 2. Standard: ASSE 1032.
 - 3. Operation: Continuous-pressure applications.
 - 4. Size: NPS 1/4 or NPS 3/8.
 - 5. Body: Stainless steel.
 - 6. End Connections: Threaded.
- G. Double-Check, Detector-Assembly Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - e. Pre-approved equal.
 - 2. Standard: ASSE 1048 and FMG approved or UL listed.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 - 5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
 - 6. End Connections: Flanged.
 - 7. Configuration: Designed for horizontal, straight through; vertical inlet, horizontal center section, and vertical outlet; or vertical flow where space constraints require.
 - 8. Accessories:
 - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- H. Hose-Connection Backflow Preventers:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Pre-approved equal.
 - 2. Standard: ASSE 1052.

3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

I. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
 - f. Pre-approved equal.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Watts Industries, Inc.; Water Products Div. for 4" valves and larger, no exceptions allowed.
 - b. Wilkins, Cla-Val, Febco, or Conbraco for valves smaller than 4", no other manufacturer's allowed.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CLA-VAL Automatic Control Valves.
 - b. Flomatic Corporation.
 - c. OCV Control Valves.
 - d. Watts Industries, Inc.; Ames Fluid Control Systems.
 - e. Watts Industries, Inc.; Watts ACV.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - g. Pre-approved equal.
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Pattern: Angle- or globe-valve design.
 - b. Trim: Stainless steel.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. ITT Industries; Bell & Gossett Div.
 - c. NIBCO INC.
 - d. TAC Americas.
 - e. Taco, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Pre-approved equal.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Pre-approved equal.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - i. Pre-approved equal.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Pipe plug.

2.6 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Symmons Industries, Inc.
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Plumbing Products Group; Light Commercial Operation.
 - k. Pre-approved equal.
2. Mounting: Recessed.

3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Pre-approved equal.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.7 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. Pre-approved equal.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.

9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Mansfield Plumbing Products LLC.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Pre-approved equal.
2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type A, for automatic draining with hose removed or Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.9 POST HYDRANTS

A. Nonfreeze, Draining-Type Post Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Prier Products, Inc.
 - c. Simmons Manufacturing Co.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. Pre-approved equal.
2. Standard: ASME A112.21.3M.
3. Type: Nonfreeze, exposed-outlet post hydrant.
4. Operation: Loose key.
5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.
6. Casing: Bronze with casing guard.
7. Inlet: NPS 3/4.
8. Outlet: Garden-hose thread complying with ASME B1.20.7.
9. Drain: Designed with hole to drain into ground when shut off.
10. Vacuum Breaker: Nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7 on outlet.
11. Operating Key(s): Two with each loose-key-operation wall hydrant.

2.10 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: NPS 3/4.
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.

2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. Pre-approved equal.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers 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 not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
 4. Install backflow preventer between 12" above floor and 60" above floor so it is easily accessible without the use of a ladder.
- C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- H. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install shutoff valve on outlet if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- J. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- K. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- L. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.
- M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.
- N. Install water hammer arresters in water piping according to PDI-WH 201.
- O. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check backflow-prevention assemblies.
 - 5. Carbonated-beverage-machine backflow preventers.
 - 6. Dual-check-valve backflow preventers.
 - 7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
 - 8. Double-check, detector-assembly backflow preventers.
 - 9. Water pressure-reducing valves.
 - 10. Calibrated balancing valves.
 - 11. Primary, thermostatic, water mixing valves.
 - 12. Manifold, thermostatic, water-mixing-valve assemblies.
 - 13. Photographic-process, thermostatic, water-mixing-valve assemblies.
 - 14. Primary water tempering valves.
 - 15. Outlet boxes.

16. Hose stations.
17. Supply-type, trap-seal primer valves.
18. 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 Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 1. Test each reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 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.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. Related Sections include the following:
 - 1. Division 22 Section "Sanitary Sewerage Pumps."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
 - 2. Sanitary Sewer, Force-Main Piping: 150 psig.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
 - 1. Sovent Drainage System: Include plans, elevations, sections, and details.
- C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International.
- C. CISPI Hubless Couplings (CISPI 310) shall be marked with NSF International.

- D. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class; manufactured by AB&I, Charlotte, or Tyler.
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301. manufactured by AB&I, Charlotte, or Tyler.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ANACO.
 - 2) Mission Rubber Co.
 - 3) Tyler Pipe; Soil Pipe Div.
 - 4) Pre-approved equal.
 - 2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ANACO/Husky SD 4000.
 - 2) Clamp-All Corp.-125.
 - 3) Pre-approved equal.
 - 3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) MG Piping Products Co.
 - 2) Pre-approved equal.

2.5 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
- C. Pressure Fittings:
 - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

D. Grooved-Joint Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Star Pipe Products; Star Fittings Div.
 - c. Victaulic Company.
 - d. Ward Manufacturing, Inc.
 - e. Pre-approved equal.
2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.
3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.6 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. 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.

2.7 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.
 - f. Plastic Oddities, Inc.
 - g. Pre-approved equal.
2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and

assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.
 - d. Pre-approved equal.

- C. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. SIGMA Corp.
 - b. Pre-approved equal.

2.9 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping shall be the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- C. Aboveground, vent piping shall be the following:
 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
- D. Underground, soil, waste, and vent piping NPS 15 and smaller shall be the following:
 1. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- E. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
 1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Steel pipe, pressure fittings, and threaded joints.
- F. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:
 1. Steel pipe, pressure fittings, and threaded joints.
 2. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.

3.3 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.
- F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- G. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- H. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- I. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- J. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- L. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- M. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- N. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- O. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- Q. Install ABS soil and waste drainage and vent piping according to ASTM D 2661.
- R. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- S. Install underground ABS and PVC soil and waste drainage piping according to ASTM D 2321.

- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - 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.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 3: 96 inches with 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.
4. NPS 6: 10 feet with 5/8-inch rod.

J. Install supports for vertical stainless-steel piping every 10 feet.

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

L. Install supports for vertical copper tubing every 10 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.
2. Sewage Pumps: To sewage pump discharge.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- E. 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. 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. 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.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Floor drains.
 - 4. Trench drains.
 - 5. Channel drainage systems.
 - 6. Roof flashing assemblies.
 - 7. Through-penetration firestop assemblies.
 - 8. Miscellaneous sanitary drainage piping specialties.
 - 9. Flashing materials.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. Grease interceptors.
 - 2. Grease removal devices.
 - 3. Oil interceptors.
- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Pre-approved equal.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Body: Cast iron.
 - 5. Cover: Cast iron with bolted or threaded access check valve.
 - 6. End Connections: Hub and spigot or hubless.
 - 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed or open for airflow unless subject to backflow condition.
 - 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - e. Pre-approved equal.
 - 2. Size: Same as floor drain outlet.
 - 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 - 4. Check Valve: Removable ball float.
 - 5. Inlet: Threaded.
 - 6. Outlet: Threaded or spigot.
- C. Horizontal, Plastic Backwater Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.

- d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Pre-approved equal.
2. Size: Same as connected piping.
 3. Body: ABS or PVC.
 4. Cover: Same material as body with threaded access to check valve.
 5. Check Valve: Removable swing check.
 6. End Connections: Socket type.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Pre-approved equal.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - h. Josam Company; Josam Div.
 - i. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - j. Pre-approved equal.
2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule; heavy-duty, adjustable housing; or threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Outlet Connection: Threaded
6. Closure: Brass plug with straight threads and gasket; or brass plug with tapered threads.
7. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
8. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
9. Frame and Cover Shape: Round or square in tiled areas.
10. Top Loading Classification: Extra Heavy in Service, Equipment and Warehouse Areas or Medium Duty.
11. Riser: ASTM A 74, Extra-Heavy in Service, Equipment and Warehouse Areas or Service class, cast-iron drainage pipe fitting and riser to cleanout.
12. Standard: ASME A112.3.1.
13. Size: Same as connected branch.
14. Housing: Stainless steel.
15. Closure: Stainless steel with seal.
16. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.
- g. Pre-approved equal.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
- 5. Closure: Countersunk or raised-head; drilled-and-threaded, brass, or cast-iron plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, deep, chrome-plated bronze, flat, chrome-plated brass or stainless-steel cover plate with countersunk screw.

2.3 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - h. Pre-approved equal.
 - 2. See Schedule on Drawings.

2.4 TRENCH DRAINS

- A. Trench Drains:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - g. Pre-approved equal.
 - 2. Standard: ASME A112.6.3 for trench drains.
 - 3. Material: Ductile or gray iron.
 - 4. See Schedule on Drawings.

2.5 CHANNEL DRAINAGE SYSTEMS

- A. Stainless-Steel Channel Drainage Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Blucher-Josam Div.
 - b. MultiDrain Systems.
 - c. Zurn Plumbing Products Group; Flo-Thru Operation.
 - d. Pre-approved equal.
 - 2. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Standard: ASME A112.3.1, for trench drains.
 - b. Channel Sections: Interlocking-joint, stainless-steel with level invert.
 - 1) Dimensions: 5.8 inches wide. Include number of units required to form total lengths indicated.
 - c. Grates: Manufacturer's designation "heavy or medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - 1) Material: Stainless steel
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - d. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
 - e. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - f. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
 - 3. See Schedule on Drawings.

- B. Polymer-Concrete Channel Drainage Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACO Polymer Products, Inc.
 - b. Josam Company; Mea-Josam Div.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Pre-approved equal.
 2. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.
 - 1) Dimensions: 4-inch inside width. Include number of units required to form total lengths indicated.
 - 2) Frame: Gray-iron or galvanized steel for grates.
 - b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - 1) Material: Ductile iron
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
 - f. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with NPS 4 outlets in number and locations indicated.
 - 1) Dimensions: 5-inch inside width and 9-3/4 inches deep. Include number of units required to form total lengths indicated.
 - 2) Frame: Gray-iron or galvanized steel for grates.
 3. See Schedule on Drawings.
- C. Polymer-Concrete Sediment Interceptor:
1. Description: 27-inch-square, precast, polymer-concrete body, with outlets in number and sizes indicated. Include 24-inch-square, gray-iron slotted grate.
 2. Frame: Gray-iron or galvanized steel for grate.
- D. FRP Channel Drainage Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACO Polymer Products, Inc.
 - b. Aquaduct, Inc.; an ACO Polymer Products, Inc. Company.
 - c. Josam Company; Mea-Josam Div.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Zurn Plumbing Products Group; Flo-Thru Operation.
 - f. Pre-approved equal.
 2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 - a. Channel Sections: Interlocking-joint, sloped-invert, FRP modular units, with end caps. Include flat, rounded, or inclined inside bottom, with outlets in number, sizes, and locations indicated.
 - 1) Dimensions: 4 or 6 inches wide. Include number of units required to form total lengths indicated.
 - 2) Frame: Manufacturer's standard metal for grates.
 - b. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
 - 1) Material: Fiberglass, galvanized steel, or gray iron.
 - 2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 - c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 - d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 - e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
 - f. See Schedule on Drawings.

2.6 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

- c. Pre-approved equal.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
1. Open-Top Vent Cap: Without cap.
 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.7 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
 - b. Hilti, Inc.
 - c. 3M, Inc.
 - d. Pre-approved equal.
 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
 3. Size: Same as connected soil, waste, or vent stack.
 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 6. Special Coating: Corrosion resistant on interior of fittings.

2.8 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.
- C. 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.
- D. 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 2 inches 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.
- E. 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.

2.9 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
1. General Applications: 12 oz./sq. ft.
 2. Vent Pipe Flashing: 8 oz./sq. ft.
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- 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 floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

- H. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.
- I. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- J. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- K. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- L. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- M. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- N. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- O. Assemble open drain fittings and install with top of hub 2 inches above floor.
- P. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- Q. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- R. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- S. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
 1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- T. Install wood-blocking reinforcement for wall-mounting-type specialties.
- U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- V. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.
- D. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

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 221319

SECTION 221323 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Grease interceptors.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of plastic interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.
- B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.
 - 1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:
 - 1. Interceptors.
 - 2. Piping connections. Include size, location, and elevation of each.
 - 3. Interface with underground structures and utility services.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of sewer services without Owner's written permission.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

- A. High-density polyethylene listed by IAPMO and ASME.
 - 1. Grease interceptor shall be lifetime guaranteed and made in USA of seamless, rotationally-molded high-density polyethylene.
 - 2. Interceptor shall be furnished for above grade installation.
 - 3. Interceptor shall be certified to ASME A112.14.3 (type C) and CSA B481.1, with field adjustable riser system, built-in flow control, built-in test caps and three outlet options.
 - 4. 4" inlet/outlet, Schedule 40, plain end.
 - 5. Max Flow Rate: 100 GPM.
 - 6. Liquid Capacity: 275 gallons.
 - 7. Max Grease Capacity: 1,076 lbs.

8. Max Solids/Sediment Capacity: 105 gallons.
9. Unit Weight with Standard Covers: 230 lbs.
10. Highway rated 16,000 lb. load.
11. Maximum operating temperature 190°F continuous.
12. Seamless molded polyethylene tank.

B. Precast concrete complying with ASTM C 913.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
 - a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - d. Walkway Load: Comply with ASTM C 890, A-03.
3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
4. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
5. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.
 - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
 - b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
 - c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR."

2.2 PRECAST-CONCRETE MANHOLE RISERS

A. Precast-Concrete Manhole Risers: ASTM C 478 or ASTM C 913, with rubber-gasket joints.

1. Structural Design Loads:
 - a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
 - b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
 - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
 - d. Walkway Load: Comply with ASTM C 890, A-03.
2. Length: From top of underground concrete structure to grade.
3. Riser Sections: 3-inch minimum thickness and 36-inch diameter.
4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
5. Gaskets: ASTM C 443, rubber.

B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.

1. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
2. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
 - a. Grease Interceptors in Sanitary Sewerage System: "GREASE INTERCEPTOR."

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

- A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.
- B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.
- D. Set tops of grating frames and grates flush with finished surface.

- E. Set plastic interceptors level and plumb.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

- A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
 1. Use warning tapes or detectable warning tape over ferrous piping.
 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 221323

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 1. Faucets for lavatories, bathtubs, bathtub/showers, showers and sinks.
 2. Fittings for bathtubs, bathtub/showers and showers.
 3. Flushometers.
 4. Toilet seats.
 5. Protective shielding guards.
 6. Fixture supports.
 7. Interceptors.
 8. Shower receptors.
 9. Disposers.
 10. Water closets.
 11. Urinals.
 12. Lavatories.
 13. Commercial sinks.
 14. Bathtubs.
 15. Individual shower enclosures.
 16. Group showers.
 17. Kitchen sinks.
 18. Service sinks and Janitor's sinks.
- B. Related Sections include the following:
 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 3. Division 22 Section "Drinking Fountains/Water Coolers."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include operation and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Mop-Service Basins: ANSI Z124.6.
 - 4. Plastic Shower Enclosures: ANSI Z124.2.
 - 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 8. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 9. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 10. Vitreous-China Fixtures: ASME A112.19.2M.
 - 11. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 12. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 13. Whirlpool Bathtub Fittings: ASME A112.19.8M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply Fittings: ASME A112.18.1.
 - 12. Brass Waste Fittings: ASME A112.18.2.

- I. Comply with the following applicable standards and other requirements specified for bathtub, bathtub/shower and shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hand-Held Showers: ASSE 1014.
 - 6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - 7. Hose-Coupling Threads: ASME B1.20.7.
 - 8. Manual-Control Antiscald Faucets: ASTM F 444.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 - 11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Manual-Operation Flushometers: ASSE 1037.
 - 4. Plastic Tubular Fittings: ASTM F 409.
 - 5. Brass Waste Fittings: ASME A112.18.2.
 - 6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Disposers: ASSE 1008 and UL 430.
 - 2. Flexible Water Connectors: ASME A112.18.6.
 - 3. Floor Drains: ASME A112.6.3.
 - 4. Hose-Coupling Threads: ASME B1.20.7.
 - 5. Off-Floor Fixture Supports: ASME A112.6.1M.
 - 6. Pipe Threads: ASME B1.20.1.
 - 7. Plastic Toilet Seats: ANSI Z124.5.
 - 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period for Commercial Applications: Three years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount, but no fewer than 2, of each type and size installed.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount, but no fewer than 2, of each type and size installed.
 - 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.
 - 4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
 - 5. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
 - 6. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.

PART 2 - PRODUCTS

2.1 FAUCETS

A. Lavatory Faucets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.
 - b. Kohler Co.
 - c. T&S Brass
 - d. Pre-approved equal.
2. See Schedule on Drawings.

2.2 FLUSHOMETERS

A. Flushometers: Manually operated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
 - b. Toto.
 - c. Pre-approved equal.
2. Description: Flushometer for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
 - a. Internal Design: Diaphragm operation.
 - b. Style: Exposed.
 - c. Inlet Size: NPS 1 or NPS 1-1/4.
 - d. Trip Mechanism: Oscillating, lever-handle actuator.
3. See Schedule on Drawings.

2.3 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company.
 - b. Church Seats.
 - c. Eljer.
 - d. Kohler Co.
 - e. Olsonite Corp.
 - f. Pre-approved equal.
2. Description: Toilet seat for water-closet-type fixture shall incorporate the following unless indicated otherwise:
 - a. Material: Molded, solid plastic with antimicrobial agent.
 - b. Configuration: Open front without cover.
 - c. Size: Elongated.
 - d. Hinge Type: SS, self-sustaining, check.
 - e. Class: Heavy-duty commercial.
 - f. Color: White.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers: Where indicated or scheduled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Insul-Tect Products Co.
 - b. McGuire Manufacturing Co., Inc.
 - c. Plumberex Specialty Products Inc.
 - d. TRUEBRO, Inc.
 - e. Zurn Plumbing Products Group.
 - f. Pre-approved equal.
2. Description: Manufactured PVC plastic pipe covers over pipe insulation or insulation wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures: Where indicated or scheduled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. TRUEBRO, Inc.
- b. Pre-approved equal.
2. Description: Manufactured plastic enclosure for concealing plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.5 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Company.
 2. Jay R. Smith.
 3. Wade.
 4. Watts.
 5. Zurn.
 6. Pre-approved equal.
- B. Water-Closet Supports:
 1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounted, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; 4" waste and 2" vent; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
 - a. Wade 310 Series.
- C. Urinal Supports:
 1. Description: Type II, urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
 - a. Wade 400-AM11 or pre-approved equal.
 2. Accessible-Fixture Support: Include rectangular steel uprights.
 - a. Wade 400-AM11-M36 or pre-approved equal.
- D. Wall-Hung Lavatory Supports:
 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 - a. Wade 520 or pre-approved equal.
 2. Accessible-Fixture Support: Include rectangular steel uprights with feet.
 - a. Wade 520-M36 or pre-approved equal.

2.6 INTERCEPTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Jay R. Smith.
 4. Wade.
 5. Watts.
 6. Zurn.
 7. Pre-approved equal.
- B. Hair Interceptors:
 1. Description: Manufactured unit with removable screen or strainer and removable cover; designed to trap and retain hair.
 - a. Material: Brass or stainless-steel body.
 - b. Pipe Connections: NPS 1-1/4 or NPS 1-1/2.
- C. Sediment Interceptors:
 1. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.
 - a. Material: Cast-iron or steel body with acid-resistant lining and coating or stainless-steel.
 - b. Pipe Connections: NPS 1-1/2 or NPS 2.

2.7 SHOWER RECEPTORS

- A. Shower Receptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fiat Products.
 - b. American Standard Companies, Inc.
 - c. Kohler Co.
 - d. Stern-Williams Co., Inc.
 - e. Pre-approved equal.
2. See Schedule on Drawings.

2.8 DISPOSERS

A. Disposers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. In-Sink-Erator.
 - b. KitchenAid.
 - c. Maytag Co.
 - d. Pre-approved equal.
2. See schedule on drawings.

2.9 WATER CLOSETS

A. Water Closets:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler Co.
 - c. TOTO USA, Inc.
 - d. Pre-approved equal.
2. See Schedule on Drawings.

2.10 URINALS

A. Urinals:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler Co.
 - c. TOTO USA, Inc.
 - d. Pre-approved equal.
2. See Schedule on Drawings.

2.11 LAVATORIES

A. Lavatories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler Co.
 - c. TOTO USA, Inc.
 - d. Pre-approved equal.
2. See Schedule on Drawings.

2.12 COMMERCIAL SINKS

A. Commercial Sinks: Stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Tabco.
 - b. Elkay Manufacturing Co.
 - c. Kohler.
 - d. Pre-approved equal.
2. See Schedule on Drawings.

2.13 WASH FOUNTAINS

A. Wash Fountains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bradley Corporation.

- b. Pre-approved equal.
- 2. See Schedule on Drawings.

2.14 BATHTUBS

A. Bathtubs:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Co.
 - b. American Standard.
 - c. TOTO, Inc.
 - d. Pre-approved equal.
- 2. See Schedule on Drawings.

2.15 INDIVIDUAL SHOWERS ENCLOSURES

A. Shower Enclosures:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aquatic.
 - b. Aqua Glass Corporation.
 - c. Florestone Products Co., Inc.
 - d. LASCO Bathware.
 - e. Fiat Products.
 - f. Kohler Co.
 - g. Pre-approved equal.
- 2. See Schedule on Drawings.

2.16 GROUP SHOWERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Bradley Corporation.
- 2. Pre-approved equal.

B. See Schedule on Drawings.

2.17 KITCHEN SINKS

A. Sinks:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kohler Co.
 - b. Elkay.
 - c. Pre-approved equal.
- 2. See Schedule on Drawings.

2.18 SERVICE SINKS/JANITOR'S SINKS

A. Service Sinks/Janitor's Sinks:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fiat Products.
 - b. Florestone Products Co., Inc.
 - c. Stern-Williams Co., Inc.
 - d. Pre-approved equal.
- 2. See Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounted fixtures with tubular waste piping attached to supports.
- F. Install floor-mounted, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounted fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install trap-seal liquid in dry urinals.
- P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- R. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- T. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

- V. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons shall be chrome plated.
- W. Set bathtubs, shower receptors and service sink basins in leveling bed of cement grout.
- X. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224700 - DRINKING FOUNTAINS/WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following drinking fountains/water coolers and related components:
 1. Pressure water coolers.
 2. Water-station water coolers.
 3. Remote water coolers.
 4. Fixture supports.

1.3 DEFINITIONS

- A. Accessible Drinking Fountain/Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler unless one is specifically indicated.
- F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- G. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act;" and Public Law 101-336, "Americans with Disabilities Act;" for fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.
- E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

- F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filter Cartridges: Equal to ten percent of amount installed for each type and size indicated, but no fewer than ten of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

- A. Water Coolers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Halsey Taylor.
 - 2. Description: ARI 1010, Type PB, pressure with bubbler, Style RE, recessed water cooler.
 - a. Cabinet: All stainless steel.
 - b. Bubbler: One, with adjustable stream regulator, located on deck for each of two bowls.
 - c. Control: Push button or bar.
 - d. Supply: NPS 3/8 with ball, gate, or globe valve.
 - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
 - f. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
 - g. 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.
 - 1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
 - h. Ventilation Grille: Stainless steel, located below fountain.
 - i. Support: Mounting frame for attaching to substrate.
 - 3. See Schedule on Drawings.

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Co.
 - 2. MIFAB Manufacturing, Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 7. Pre-approved equal.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 - 1. Type I: Hanger-type carrier with two vertical uprights.
 - 2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
 - 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.6 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

3.7 CLEANING

- A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Coordination procedures.
 2. Piping materials and installation instructions common to most piping systems.
 3. Transition fittings.
 4. Dielectric fittings.
 5. Mechanical sleeve seals.
 6. Sleeves.
 7. Escutcheons.
 8. Grout.
 9. Equipment installation requirements common to equipment sections.
 10. Painting and finishing.
 11. Concrete bases.
 12. Supports and anchorages.

1.3 GENERAL COORDINATION PROCEDURES

- A. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, 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 other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Construction Manager and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.4 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."

1.5 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.

- B. Welding certificates.

1.7 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.9 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Eslon Thermoplastics.
 - b. Pre-approved equal.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thompson Plastics, Inc.
 - b. Pre-approved equal.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
 - c. Pre-approved equal.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
 - h. Pre-approved equal.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300-psig minimum working pressure as required to suit system pressures.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Pre-approved equal.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Pre-approved equal.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150 or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
 - c. Pre-approved equal.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.
 - e. Pre-approved equal.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Pre-approved equal.
 2. Sealing Elements: EPDM 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. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping 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. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and screw or spring clips
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.

- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using 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.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Braze Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 1. Construct concrete bases a minimum of 4 inches and a maximum of 6 inches deep, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi 28-day compressive-strength concrete and reinforcement as specified

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, 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 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-

- actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
 - F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - H. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
 - J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
 - L. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper 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 NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.

6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 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 NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- 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.
- 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. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 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. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger 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 230529

SECTION 230553 - HVAC SYSTEM IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 1. Equipment nameplates.
 2. Equipment markers.
 3. Equipment signs.
 4. Access panel and door markers.
 5. Pipe markers.
 6. Duct markers.
 7. Valve tags.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 2. Location: Accessible and visible.
 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
 1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
 1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/16 inch, unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
 1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 deg rees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch-thick brass.
2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

- b. Meters, gages, thermometers, and similar units.
 - c. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - e. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - f. Fans, blowers, primary balancing dampers, and mixing boxes.
 - g. Packaged HVAC central-station and zone-type units.
 - h. Tanks and pressure vessels.
 - i. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
- 1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 - c. Orange: For combination cooling and heating equipment and components.
 - d. Brown: For energy-reclamation equipment and components.
 - 2. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
- 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
 - 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 - 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 - 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
- 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
- 1. Green: For cold-air supply ducts.

2. Yellow: For hot-air supply ducts.
3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:
 - a. Cold Water: 1-1/2 inches, round.
 - b. Hot Water: 1-1/2 inches, round.
 - c. Gas: 1-1/2 inches, round.
 - d. Steam: 1-1/2 inches, round.
2. Valve-Tag Color:
 - a. Cold Water: Blue.
 - b. Hot Water: Red.
 - c. Gas: Yellow.
3. Letter Color:
 - a. Cold Water: White.
 - b. Hot Water: White.
 - c. Gas: White.

3.6 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- B. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Variable-flow hydronic systems.

1.2 DEFINITIONS

- A. NEBB: National Environmental Balancing Bureau.
- B. TAB: Testing, adjusting, and balancing.
- C. TAB Specialist: An entity engaged to perform TAB Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- B. Certified TAB reports.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Owner and Commissioning Authority.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump 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.
- 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 HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine system pumps to ensure absence of entrained air in the suction piping.
- N. Examine operating safety interlocks and controls on HVAC equipment.
- O. 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.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."
- M. Install clean air filters.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record final fan-performance data.

- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
1. Open all manual valves for maximum flow.
 2. Check liquid level in expansion tank.
 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.9 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. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.10 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 6. Capacity: Calculate in tons of cooling.
 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.11 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
1. Measure condenser-water flow to each cell of the cooling tower.
 2. Measure entering- and leaving-water temperatures.
 3. Measure wet- and dry-bulb temperatures of entering air.
 4. Measure wet- and dry-bulb temperatures of leaving air.
 5. Measure condenser-water flow rate recirculating through the cooling tower.
 6. Measure cooling-tower spray pump discharge pressure.
 7. Adjust water level and feed rate of makeup water system.
 8. Measure flow through bypass.

3.12 PROCEDURES FOR BOILERS

- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
1. Nameplate data.
 2. Airflow.

3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.14 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.15 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.16 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 systems' balancing devices. Recommend changes and additions to systems' 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 weekly 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.

3.17 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 - 1. Quantities of outdoor, supply, return, and exhaust airflows.
 - 2. Water and steam flow rates.
 - 3. Duct, outlet, and inlet sizes.
 - 4. Pipe and valve sizes and locations.
 - 5. Terminal units.
 - 6. Balancing stations.
 - 7. Position of balancing devices.

3.18 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 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Related Sections:
 - 1. Section 233113 "Metal Ducts" for ductwork with lining.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets or covering.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- 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.

1.8 SCHEDULING

- A. Schedule insulation application after any required ductwork pressure testing is complete. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Duct Insulation Schedule for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Owens Corning; SOFTR All-Service Duct Wrap.
 - e. Pre-approved equal.
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Johns Manville; 800 Series Spin-Glas.
 - c. Knauf Insulation; Insulation Board.
 - d. Owens Corning; Fiberglas 700 Series.
 - e. Pre-approved equal.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Super Firetemp M.
 - b. Pabco.
 - c. Pre-approved equal.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. 3M; Fire Barrier Wrap Products.
 - d. Pre-approved equal.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-127.
 - b. Eagle Bridges; 225.
 - c. Foster Brand; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. Pre-approved equal.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-82.
 - b. Eagle Bridges; 225.
 - c. Foster Brand; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - e. Pre-approved equal.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. Pre-approved equal.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-50 AHV2.
 - b. Foster Brand; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d. Pre-approved equal.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. FSK Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-76.
 - b. Eagle Bridges; 405.
 - c. Foster Brand; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pre-approved equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 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 C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI; 491 AWF FSK.
 - b. Avery Dennison Corporation; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - e. Pre-approved equal.
 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.

2.10 SECUREMENTS

- A. Insulation Pins and Hangers:
 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.

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, vapor barriers or retarders, 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, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Keep insulation materials dry during application and finishing.
- E. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- F. Install insulation with least number of joints practical.
- G. Where vapor barrier is indicated, seal joints, seams, and penetrations. No penetration in insulation is permitted at hangers, supports, and other projections.
 - 1. Install insulation continuously through hangers and supports.
 - 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.
- H. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- I. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive sealing tape.
 - 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.
- J. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- K. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- L. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Firestopping materials and fire-resistive joint sealers applicable for the installation.
- C. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket or 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 capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides or bottom 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 or bottom 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 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. 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.
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.

3.6 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

- A. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 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).
- 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 pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 4. Detail removable insulation at piping specialties.
 - 5. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

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.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields.
- 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.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Piping Insulation Schedule.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells.
 - 1. Products: Subject to compliance with requirements, provide the following or equivalent:
 - a. Pittsburgh Corning Corporation; Foamglas.
 - b. Pre-approved equal.
 - 2. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 3. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- E. Flexible Elastomeric Insulation: Closed-cell, expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
 - d. Pre-approved equal.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I or Type II.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Pre-approved equal.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 - e. Pre-approved equal.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aero seal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.

- e. Pre-approved equal.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-127.
 - b. Eagle Bridges; 225.
 - c. Foster Brand; 85-60/85-70.
 - d. Pre-approved equal.
 - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-82.
 - b. Eagle Bridges; 225.
 - c. Foster Brand; 85-50.
 - d. Pre-approved equal.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - e. Pre-approved equal.
 - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Foster Brand; 30-80/30-90.
 - b. Vimasco Corporation; 749.
 - c. Pre-approved equal.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
- 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand; CP-50 AHV2.
 - b. Foster Brand; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - d. Pre-approved equal.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 4. Service Temperature Range: 0 to plus 180 deg F.

5. Color: White.

2.6 SEALANTS

- A. ASJ Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: White.
 5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules. Use the following shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps and mechanical joints.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - e. Pre-approved equal.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers.
- C. Metal Jacket:
 1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Corrugated, 0.024 inch thick.
 - b. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-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.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. Pre-approved equal.
 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.

2.10 SECUREMENTS

- A. Bands:
1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

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.
 3. 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.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

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 thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at bottom of horizontal runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during application and finishing.
- 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. Where vapor barrier is indicated, seal joints and seams. No penetration of insulation at hangers or supports is allowed. Seal anchors, guides and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- 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.
 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.
 4. On hot services it is permissible to staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, no staples are allowed.
 5. Cover joints and seams with tape, according to 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.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- 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.

3.4 PENETRATIONS

- A. 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.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Install with firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 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.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded

- with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Install insulation as inserts at pipe hangers and supports.
1. Insulation shall be the same thickness as the adjoining insulation.
 2. Provide factory applied jacket the same material as the adjoining insulation.

3.7 INSTALLATION OF MINERAL-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 factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. 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.

B. 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 FIELD QUALITY CONTROL

A. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION 230719

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.2 SUBMITTALS

- A. Product Data: For each control device indicated.
- B. Shop Drawings:
 - 1. Schematic flow diagrams.
 - 2. Power, signal, and control wiring diagrams.
 - 3. Details of control panel faces.
 - 4. Valve schedule.
 - 5. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
 - 6. Control System Software: Schematic diagrams, written descriptions, and points list.
- C. Software and firmware operational documentation.
- D. Field quality-control test reports.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

- A. Schneider Electric by C&C Group.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- D. All point of user interface shall be on standard PC's that do not require the purchase of special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PC's will be a standard web browser.
- E. The BMS shall be a web-based application with microprocessor-based interoperable BACnet or LonWorks controllers in accordance with the ANSI/ASHRAE 135-2004 and most recent addendums. The system supplier must provide a PICS document showing the installed systems compliance level to the ANSI/ASHRAE Standard

135-2004. The BMS system shall communicate using the BACnet or LonWorks "open" protocol at both the supervisor and device level.

- F. Integration of standalone microprocessors into the BMS shall be provided by either hardware points or as part of the packaged equipment control. Acceptable protocols to be provided for integration are:
1. BACnet IP
 2. BACnet Ethernet
 3. BACnet MSTP
 4. BACnet ARCnet
 5. Modbus RTU
- G. BMS points in addition to and including those outlined herein or on the drawings shall be provided:
1. Temperatures after each coil shall be monitored.
 2. Temperatures before and after any heat transfer occurrence, such as at the inlet and outlet of the energy recovery unit heat recovery wheel.
 3. Supply air temperature, return air temperature, mixed air temperature and space temperature shall be monitored for each unit.
 4. Digital status for each piece of controlled equipment shall be monitored.
 5. For each physical point provide a document which, at a minimum, shall indicate the following:
 - A. User point identification name
 - B. Logical point name
 - C. Alarmable (yes or no)
 - D. Point description
 - E. BMS panel ID
 - F. Fail position (open/closed, on/off)
 - G. Digital or Analog
 - H. Analog control range (temperature, pressure, etc.)
 - I. Analog input/output range (Volts, mA, psi, etc.)
 - J. Analog high limit alarm
 - K. Analog low limit alarm
 - L. For each virtual point provide a document which, at a minimum, shall indicate the following: User point identification name, Logical point name, Point function and use.
 6. All input points shall be alarmed. All alarms shall allow recognition, management and remote alarming.
- H. The system shall be capable of supporting an unlimited number of clients using a standard web browser such as Internet Explorer or Mozilla Firefox. Systems requiring additional software (to enable a standard web browser) to be resident on the client machine, or manufacturer-specific browsers shall not be acceptable.

2.3 DDC EQUIPMENT

- A. Operator Workstation: PC-based microcomputer with minimum configuration as follows:
1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 2. Processor: Intel Pentium 4, 2.0 GHz.
 3. Random-Access Memory: 512MB.
 4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
 5. Monitor: 17 inches, LCD color.
 6. Keyboard: QWERTY, 105 keys in ergonomic shape.
 7. Floppy-Disk Drive: 1.44 MB.
 8. Hard-Disk Drive: 80 GB.
 9. CD-ROM Read/Write Drive: 48x24x48.
 10. Mouse: Three button, optical.
 11. Uninterruptible Power Supply: 2 kVa.
 12. Operating System: Microsoft Windows XP Professional with high-speed Internet access.
 13. Printer: Color, ink-jet type as follows:
 - A. Print Head: 4800 x 1200 dpi optimized color resolution.
 - B. Paper Handling: Minimum of 100 sheets.
 - C. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
 - D. Application Software.
- B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - A. Global communications.
 - B. Discrete/digital, analog, and pulse I/O.
 - C. Monitoring, controlling, or addressing data points.
 - D. Software applications, scheduling, and alarm processing.
 - E. Testing and developing control algorithms without disrupting field hardware and controlled environment.

- C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - A. Global communications.
 - B. Discrete/digital, analog, and pulse I/O.
 - C. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation.

- D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.

- E. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

- F. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
 1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 1. Configuration: Diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
 3. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.5 ANALOG CONTROLLERS

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.6 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
 - 4. Averaging Elements in Ducts: 36 inches long, flexible, 18 inches long, rigid; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - A. Set-Point Adjustment: Exposed.
 - B. Set-Point Indication: Concealed.
 - C. Thermometer: Concealed.
 - D. Color: color selection from manufacturer's full range.
 - E. Orientation: Vertical.
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. Pressure Transmitters/Transducers:
 - 1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - A. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - B. Output: 4 to 20 mA.
 - C. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - D. Duct Static-Pressure Range: 0- to 5-inch wg.
 - 2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 - 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 - 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 - 5. Pressure Transmitters: Direct acting for gas or liquid service; range suitable for system; linear output 4 to 20 mA.

2.7 STATUS SENSORS

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.8 THERMOSTATS

- A. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 - 5. Short-cycle protection.
 - 6. Programming based on weekday, Saturday, and Sunday.
 - 7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
 - 8. Battery replacement without program loss.
 - 9. Thermostat display features include the following:
 - A. Time of day.
 - B. Actual room temperature.
 - C. Programmed temperature.
 - D. Programmed time.
 - E. Duration of timed override.
 - F. Day of week.
 - G. System mode indications include "heating," "off," "fan auto," and "fan on."
- B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.
 - 2. Bulbs in air ducts with flanges and shields.
 - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 - 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- E. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
 - 1. Reset: Manual.

2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- F. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Exposed.
 2. Set-Point Indication: Concealed.
 3. Thermometer: Concealed.
 4. Color: Color selection from manufacturer's full range.
 5. Orientation: Vertical.
- G. Room thermostat accessories include the following:
1. Insulating Bases: For thermostats located on exterior walls.
 2. Thermostat Guards: Metal wire, tamperproof.
 3. Adjusting Key: As required for calibration and cover screws.
 4. Set-Point Adjustment: 1/2-inch- diameter, adjustment knob.
- H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
- I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- J. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- K. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
- L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.

2.9 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
1. Comply with requirements in Division 15 Section "Motors."
 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 2. Dampers: Size for running torque calculated as follows:
 - A. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - B. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - C. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - D. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - E. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.

- F. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
- 3. Coupling: V-bolt and V-shaped, toothed cradle.
- 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
- 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
- 6. Power Requirements (Two-Position Spring Return): 24-V ac.
- 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
- 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
- 9. Temperature Rating: Minus 22 to plus 122 deg F.
- 10. Run Time: 150 seconds.

2.10 CONTROL VALVES

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system globe valves shall have the following characteristics:
 - 1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 - 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 - 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - A. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - B. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 - 4. Sizing: 3-psig maximum pressure drop at design flow rate or the following:
 - A. Two Position: Line size.
 - B. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - C. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 - 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

2.11 DAMPERS

- A. Dampers: AMCA-rated, parallel-blade design; 0.108-inch minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 - 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 - 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 - 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.12 CONTROL CABLE

- A. All exposed cable and cable installed above in accessible ceilings shall be in conduit. Plenum rated cable is acceptable for installation above accessible ceilings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- B. Install guards on thermostats in the following locations:
 1. Where indicated.
- C. Install automatic dampers according to Division 15 Section "Duct Accessories."
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."
- F. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."
- G. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."
- H. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. All electrical control wiring and power wiring to control panels shall be the responsibility of the controls contractor.
- B. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."
- C. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- D. Install signal and communication cable as described below:
 1. Install exposed cable in raceway.
 2. Install concealed cable in raceway.
 3. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 6. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- E. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 2. Test and adjust controls and safeties.
 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 6. Test each system for compliance with sequence of operation.
 7. Test software and hardware interlocks.

- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 6. Check temperature instruments and material and length of sensing elements.
 - 7. Check control valves. Verify that they are in correct direction.
 - 8. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
 - 9. Check DDC system as follows:
 - A. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - B. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - C. Verify that spare I/O capacity has been provided.
 - D. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 CONTROL AND MONITORING POINTS

- A. All systems not included below:
- B. 1. Refer to Sequence of Operation on Drawings.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative for minimum 24 hours of on-site training (six 4-hour sessions) to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 230900

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.
 - 6. Concrete bases.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
 - 2. Service Regulators: 100 psig minimum unless otherwise indicated.
 - 3. Minimum Operating Pressure of Service Meter: 5 psig.
- B. Natural-Gas System Pressure within Buildings: 2.0 psig or less.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.
 - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
 - 4. Pressure regulators. Indicate pressure ratings and capacities.
 - 5. Dielectric fittings.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
 - 1. Shop Drawing Scale: 1/4 inch per foot.
 - 2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

- C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- C. Qualification Data: For qualified professional engineer.
- D. Welding certificates.
- E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

1.10 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of natural-gas service.
 2. Do not proceed with interruption of natural-gas service without Construction Manager's written permission.

1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
 - 5. Mechanical Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - 3) Pre-approved equal.
 - b. Stainless-steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Stainless-steel bolts, washers, and nuts.
 - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig.
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72 inches
- C. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.
- D. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 - 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig.
- E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.2 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.3 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
 - 1. CWP Rating: 125 psig.
 - 2. Threaded Ends: Comply with ASME B1.20.1.
 - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
 - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
 - 1. CWP Rating: 125 psig.
 - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 - f. Pre-approved equal.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Ball: Chrome-plated bronze.
 - 4. Stem: Bronze; blowout proof.
 - 5. Seats: Reinforced TFE; blowout proof.
 - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 8. CWP Rating: 600 psig.
 - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.
 - c. Pre-approved equal.
 - 2. Body: Bronze, complying with ASTM B 584.
 - 3. Plug: Bronze.
 - 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 - 5. Operator: Square head or lug type with tamperproof feature where indicated.
 - 6. Pressure Class: 125 psig.

7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flowserve.
 - b. Homestead Valve; a division of Olson Technologies, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Milliken Valve Company.
 - e. Mueller Co.; Gas Products Div.
 - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
 - g. Pre-approved equal.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.4 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASCO Power Technologies, LP; Division of Emerson.
 - b. Dungs, Karl, Inc.
 - c. Eaton Corporation; Controls Div.
 - d. Eclipse Combustion, Inc.
 - e. Honeywell International Inc.
 - f. Johnson Controls.
 - g. Pre-approved equal.
2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASCO Power Technologies, LP; Division of Emerson.
 - b. Dungs, Karl, Inc.
 - c. Eclipse Combustion, Inc.
 - d. Goyen Valve Corp.; Tyco Environmental Systems.
 - e. Magnatrol Valve Corporation.
 - f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
 - g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
 - h. Pre-approved equal.
2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.5 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for natural gas.
 2. Steel jacket and corrosion-resistant components.
 3. Elevation compensator.
 4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. Service Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - d. Invensys.
 - e. Richards Industries; Jordan Valve Div.
 - f. Pre-approved equal.
 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 12. Maximum Inlet Pressure: 100 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.
 - g. Richards Industries; Jordan Valve Div.
 - h. Pre-approved equal.
 2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
 3. Springs: Zinc-plated steel; interchangeable.
 4. Diaphragm Plate: Zinc-plated steel.
 5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
 6. Orifice: Aluminum; interchangeable.
 7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
 8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
 9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
 10. Overpressure Protection Device: Factory mounted on pressure regulator.
 11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
 12. Maximum Inlet Pressure: 5 psig.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
 - f. Pre-approved equal.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International Ltd.
 - e. Matco-Norca, Inc.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
 - i. Pre-approved equal.
 2. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Matco-Norca, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Wilkins; a Zurn company.
 - f. Pre-approved equal.
 2. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 150 psig.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Pre-approved equal.
 2. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

2.7 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of

utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.
 - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
 - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
 - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
 - 3. Replace pipe having damaged PE coating with new pipe.
- E. Install fittings for changes in direction and branch connections.
- F. Install pressure gage downstream from each service regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.

- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
 - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 - 5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Section 230519 "Meters and Gages for HVAC Piping."
- W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

- Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground, on concrete bases.
- B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.
- C. Install strainer on inlet of service-pressure regulator and meter set.
- D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.
- E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.
- F. Install service meters downstream from pressure regulators.
- G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
 - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

3.9 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

- A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel (semigloss).
 - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex (low sheen).
 - d. Color: Gray.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd (eggshell).
 - d. Color: Gray.

- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base.
 - 1. Construct concrete bases a minimum of 4 inches and a maximum of 6 inches high, and not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Use 3000-psi, 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.14 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE

- A. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- B. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
 - 2. Steel pipe with wrought-steel fittings and welded joints.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 UNDERGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Connections to Existing Gas Piping: Use valve and fitting assemblies made for tapping utility's gas mains and listed by an NRTL.

3.18 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, nonlubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.
- D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:
 - 1. Two-piece, full-port, bronze ball valves with bronze trim.
 - 2. Bronze plug valve.
 - 3. Cast-iron, lubricated plug valve.
- E. Valves in branch piping for single appliance shall be one of the following:
 - 1. One-piece, bronze ball valve with bronze trim.
 - 2. Two-piece, full-port, bronze ball valves with bronze trim.
 - 3. Bronze plug valve.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Condensate-drain piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Copper pipe and fittings.
 - 2. Pressure-seal fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Welding certificates.
- C. Field quality-control reports.
- D. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
- C. DWV Copper Tubing: ASTM B 306, Type DWV.
- D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
 - 1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
 - 2. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
- F. Wrought-Copper Unions: ASME B16.22.

2.2 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

- b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
 - C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 - D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
 - E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.
- 2.3 TRANSITION FITTINGS
- A. Plastic-to-Metal Transition Fittings:
 - 1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- 2.4 DIELECTRIC FITTINGS
- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 - B. Dielectric Unions:
 - 1. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 deg F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- Q. Install shutoff valve immediately upstream of each dielectric fitting.
- R. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4: Maximum span, 7 feet.
 2. NPS 1: Maximum span, 7 feet.
 3. NPS 1-1/2: Maximum span, 9 feet.
 4. NPS 2: Maximum span, 10 feet.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.

- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig
 - 2. Suction Lines for Heat-Pump Applications: 325 psig
 - 3. Hot-Gas and Liquid Lines: 325 psig

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 2. End Connections: Socket ends.
 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch long assembly.
 4. Pressure Rating: Factory test at minimum 500 psig
 5. Maximum Operating Temperature: 250 deg F

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 3. Operator: Rising stem and hand wheel.
 4. Seat: Nylon.
 5. End Connections: Socket, union, or flanged.
 6. Working Pressure Rating: 500 psig
 7. Maximum Operating Temperature: 275 deg F
- B. Packed-Angle Valves:
 1. Body and Bonnet: Forged brass or cast bronze.
 2. Packing: Molded stem, back seating, and replaceable under pressure.
 3. Operator: Rising stem.
 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 5. Seal Cap: Forged-brass or valox hex cap.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Working Pressure Rating: 500 psig
 8. Maximum Operating Temperature: 275 deg F
- C. Check Valves:
 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 3. Piston: Removable polytetrafluoroethylene seat.
 4. Closing Spring: Stainless steel.
 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Maximum Opening Pressure: 0.50 psig
 8. Working Pressure Rating: 500 psig
 9. Maximum Operating Temperature: 275 deg F
- D. Service Valves:
 1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig
- E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
 1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24V ac coil.
 6. Working Pressure Rating: 400 psig
 7. Maximum Operating Temperature: 240 deg F
 8. Manual operator.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.

4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig
 6. Maximum Operating Temperature: 240 deg F
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F
 6. Superheat: Adjustable
 7. End Connections: Socket, flare, or threaded union.
 8. Working Pressure Rating: 700 psig
- H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig
 5. Maximum Operating Temperature: 275 deg F
- I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig
 6. Maximum Operating Temperature: 275 deg F
- J. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig
 7. Maximum Operating Temperature: 240 deg F
- K. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina
 4. End Connections: Socket.
 5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 6. Maximum Pressure Loss: 2 psig
 7. Working Pressure Rating: 500 psig
 8. Maximum Operating Temperature: 240 deg F
- L. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig
 8. Working Pressure Rating: 500 psig
 9. Maximum Operating Temperature: 240 deg F
- M. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or threaded.
 3. Working Pressure Rating: 500 psig
 4. Maximum Operating Temperature: 275 deg F

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
- B. Hot-Gas and Liquid Lines, Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR drawn-temper tubing and wrought-copper fittings with soldered joints.
- D. Safety-Relief-Valve Discharge Piping:
 - 1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
 - 2. L drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves according to 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 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAG, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 Maximum span, 60 inches minimum rod size, 1/4 inch
 - 3. NPS 1: Maximum span, 72 inches minimum rod size, 1/4 inch
 - 4. NPS 1-1/4: Maximum span, 96 inches minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2 Maximum span, 96 inches minimum rod size, 3/8 inch
- D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties. 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 Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

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 except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Low pressure rectangular ducts and fittings.
 2. Low pressure ductwork.
 3. Medium pressure ductwork.
 4. Single-wall round and flat-oval ducts and fittings.
 5. Single-wall round ductwork.
 6. Double-wall round and flat-oval ducts and fittings.
 7. Double-wall round ductwork.
 8. Sheet metal materials.
 9. Duct liner.
 10. Sealants and gaskets.
 11. Hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 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 main duct runs from building grid lines.
 6. Fittings.
 7. Reinforcement and spacing.
 8. Seam and joint construction.
 9. Penetrations through fire-rated and other 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. LEED Submittals:
 1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
 2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
 3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 - "Duct Leakage Tests."
 4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 - "Ventilation System Start-up."

5. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
6. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.

1.6 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 1. Galvanized Coating Designation: G60.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Duct materials other than the above is specified in the particular ductwork description.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be as indicated in the Duct Schedule.
- E. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, exposed matte finish.

2.2 LOW PRESSURE RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995" based on 2" w.g. static-pressure class, Table 1-5.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995," Tables 1-10 through 1-13, "Rectangular Duct/Transverse Joints," for 2" w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995," Figure 1-5, "Rectangular Duct/Longitudinal Seams," for 2" w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995," Chapter 2, "Fittings and Other Construction," for 2" w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995."
 - 1. All elbows or offsets in rectangular ductwork under positive pressure shall contain turning vanes. Turning vanes in low pressure ductwork shall be single wall.
 - 2. All rectangular branch takeoffs in supply ductwork shall be of the 45 deg. entry design with a manual damper. Round take-offs in supply ductwork shall use rectangular to round transition with 45 degree entry design and a manual damper in the round, Sheet Metal Connectors H.E.T. (Hi-Efficiency Take-Off) or equal.

2.3 MEDIUM PRESSURE RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995" based on 4" w.g. static-pressure class, Table 1-5.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for 4" w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for 4" w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995," Chapter 2, "Fittings and Other Construction," for 4" w.g. static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995."
 - 1. All elbows or offsets in rectangular ductwork that exceed 33 degrees shall contain turning vanes. Turning vanes in medium pressure ductwork shall be double wall.
 - 2. Rectangular branch take-offs shall be of the 45 deg. entry design as detailed in SMACNA "HVAC Duct Construction Standards, Second Edition-1995," Figure 2-6. Round branch take-offs or taps shall be of the conical or bellmouth design or 45 deg. rectangular to round entry design with sealer and mechanical fasteners used at tap connection. Round take-offs larger than duct height shall be of the 45 deg. entry design with a rectangular to round branch connections. The rectangular area shall be a minimum of 1-1/2 times the round branch area. Sealer shall be used at the branch connection.

2.4 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Low pressure round ducts shall be constructed per SMACNA HVAC Construction Standards, Table 3-2, 2" w.g. (pos.), Second Edition, 1995 with Addendum No. 1, for galvanized steel with grooved longitudinal seam and sleeved type transverse joint, pipe riveted. Hangers shall be 2" band, attached at duct joints with draw bands. Spiral duct and fittings per paragraph below may be used as an option.
- B. Round ducts in medium pressure systems and ahead of terminal boxes shall be of the continuous weld or continuous lock seam construction from ASTM A-527-67 galvanized steel. All round fittings shall be manufactured from galvanized steel with continuous welds or locked seams. Gasketed self-sealing spiral duct and fittings installed in accordance with manufacturer's instructions may be used. All round ducts and fittings shall be equal constructed to the gauges called for in SMACNA HVAC Round Duct Construction Standards, Table 3-2, for spiral lock seam duct, 10" w.g., Second Edition, 1995 with Addendum No. 1.
- C. All exposed round ducts regardless of system pressure, shall be constructed as described in paragraph B above.
- D. All round ducts shall be sealed per SMACNA seal classification "B" requirements.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, 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 Corporation.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Pre-approved equal.
 2. Minimum Thermal Conductivity:
 - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. 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 shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. 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. 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.
 6. 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.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. 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 according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a minimum clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
- D. All elbow or offsets exceeding 33 degrees shall utilize sweep/radius elbows with a centerline radius equal to or greater than the duct width.

3.4 ADDITIONAL INSTALLATION REQUIREMENTS FOR DISHWASHER EXHAUST DUCT

- A. Solder ducts water tight. Install stainless steel damper with locking quadrant in the drops to the dishwasher. Ductwork shall be sloped to drain to the connection at the dirty dish end of the dishwasher.

3.5 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in ductwork schedule on drawings.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible, Second Edition-1995," Chapter 4, "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.

3.7 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, Second Edition-1995" for branch, outlet and inlet, and terminal unit connections.

3.8 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.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Test for leaks before applying external insulation.
 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 1. Visually inspect duct system to ensure that no visible contaminants are present.
 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

3.10 DUCT CLEANING

- A. Clean duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.

- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide drainage and cleanup for wash-down procedures.
 - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.11 START UP

- A. Air Balance: Comply with requirements in "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows.
- B. Refer to ductwork schedule on drawings.

END OF SECTION 233113

SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Fire dampers.
 - 4. Smoke dampers.
 - 5. Combination fire and smoke dampers.
 - 6. Turning vanes.
 - 7. Duct-mounting access doors.
 - 8. Flexible connectors.
 - 9. Flexible ducts.
 - 10. Duct accessory hardware.
 - 11. Duct silencers.
- B. See "Fire Alarm" for duct-mounting fire and smoke detectors.
- C. See Division 23 Section "HVAC Instrumentation and Controls" for electric and pneumatic damper actuators.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Fire dampers.
 - 4. Ceiling fire dampers.
 - 5. Smoke dampers.
 - 6. Combination fire and smoke dampers.
 - 7. Turning vanes.
 - 8. Duct-mounting access doors.
 - 9. Flexible connectors.
 - 10. Flexible ducts.
 - 11. Duct Silencers.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Special fittings.
 - 2. Manual-volume damper installations.
 - 3. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.
 - 4. Wiring Diagrams: Power, signal, and control wiring.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. 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.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance, Inc.
 - 2. American Warming and Ventilating.
 - 3. CESCO Products.
 - 4. Duro Dyne Corp.
 - 5. Greenheck.
 - 6. Penn Ventilation Company, Inc.
 - 7. Prefco Products, Inc.
 - 8. Ruskin Company.
 - 9. Vent Products Company, Inc.
 - 10. Pre-approved equal.
- B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Frame: 0.052-inch-thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: 0.050-inch-thick aluminum sheet.
- E. Blade Seals: Neoprene.
- F. Blade Axles: Galvanized steel.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance, Inc.
 - 2. American Warming and Ventilating.
 - 3. Flexmaster U.S.A., Inc.
 - 4. McGill AirFlow Corporation.
 - 5. METALAIRE, Inc.
 - 6. Nailor Industries Inc.
 - 7. Penn Ventilation Company, Inc.
 - 8. Ruskin Company.

9. Vent Products Company, Inc.
10. Greenheck Fan Corporation
11. Pre-approved equal.

- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
 3. Blade Axles: Galvanized steel.
 4. Bearings: Oil-impregnated bronze.
 5. Tie Bars and Brackets: Galvanized steel.
- D. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 FIRE DAMPERS

- A. Manufacturers:
1. Air Balance, Inc.
 2. CESCO Products.
 3. Greenheck.
 4. McGill AirFlow Corporation.
 5. METALAIRE, Inc.
 6. Nailor Industries Inc.
 7. Penn Ventilation Company, Inc.
 8. Prefco Products, Inc.
 9. Ruskin Company.
 10. Vent Products Company, Inc.
 11. Ward Industries, Inc.
 12. Pre-approved equal.
- B. Fire dampers shall be labeled according to UL 555.
- C. Fire Rating: 1-1/2 hours for dampers in walls rated 2-hours or less. 3 hour rating for dampers in walls rated greater than 2-hours.
- D. Frame: Low pressure applications (2" wg and less): curtain type with blades inside airstream; for ductwork constructed in higher pressure applications (above 2" wg): curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.138 inch thick and of length to suit application.
 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Fusible Links: Replaceable, 165 deg F rated.

2.6 SMOKE OR COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. CESCO Products.
3. Greenheck.
4. Nailor Industries Inc.
5. Penn Ventilation Company, Inc.
6. Ruskin Company.
7. Pre-approved equal

B. General Description: Labeled according to UL 555S. Combination fire and smoke dampers shall be labeled according to UL 555 for 1-1/2-hour rating.

C. Fusible Links: Replaceable, 165 deg F rated.

D. Frame and Blades: 0.064-inch-thick, galvanized sheet steel.

E. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application.

F. Damper Motors: Modulating and two-position action.

1. Motors: With oil-immersed and sealed gear trains.
2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
4. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
5. Electrical Connection: 115 V, single phase, 60 Hz.

2.7 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, double-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. METALAIRE, Inc.
 - d. Ward Industries, Inc.
 - e. Pre-approved equal.

C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.8 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating.
 - b. CESCO Products.
 - c. Ductmate Industries, Inc.
 - d. Flexmaster U.S.A., Inc.

- e. Greenheck.
 - f. McGill AirFlow Corporation.
 - g. Nailor Industries Inc.
 - h. Ventfabrics, Inc.
 - i. Ward Industries, Inc.
 - j. Elgen Manufacturing
 - k. Pre-approved equal.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Provide number of hinges and locks as follows:
 - a. Less Than 12 Inches Square: Secure with two sash locks.
 - b. Up to 18 Inches Square: Two hinges and two sash locks.
 - c. Up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ductmate Industries, Inc.
 - b. Flexmaster U.S.A., Inc.
 - c. Pre-approved equal.
 2. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Corp.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.
 5. Pre-approved equal.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. 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.

2.10 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
 2. Thermaflex.
 3. McGill AirFlow Corporation.
 4. Pre-approved equal.
- B. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.11 DUCT ACCESSORY HARDWARE

- A. 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.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.12 DUCT SILENCERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Industrial Acoustics Company.
 - 2. Vibroacoustics.
 - 3. Pre-approved equal.
- B. General Requirements:
 - 1. Furnish and install "Quiet-Duct" (rectangular) silencers of the types and sizes shown on the plans and/or listed in the schedule. Silencers shall be the product of Industrial Acoustics Company. Any specification change must be submitted in writing and approved by the Architect/Engineer, in writing, at least 10 days prior to the bid due-date.
- C. Materials:
 - 1. Outer casings of rectangular silencers shall be made of 22 gauge type #G-90 lock-former-quality galvanized steel.
 - 2. Interior partitions for rectangular silencers shall be not less than 26 gauge type #G-90 galvanized lock-former-quality perforated steel.
 - 3. Filler material shall be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin- and moisture-proof.
 - 4. Combustion ratings for the silencer acoustic fill shall be not greater than the following when tested to ASTM E 84, NFPA Standard 255, or UL No. 723:
 - a. Flamespread Classification: 20.
 - b. Smoke Development Rating: 20.
- D. Construction:
 - 1. Units shall be constructed in accordance with the ASHRAE Guide recommendations for high pressure duct work. Seams shall be lock formed and mastic filled. Rectangular casing seams shall be in the corners of the silencer shell to provide maximum unit strength and rigidity. Interior partitions shall be fabricated from single-piece, margin-perforated sheets and shall have die-formed entrance and exit shapes so as to provide the maximum aerodynamic efficiency and minimum self-noise characteristics in the sound attenuator. Blunt noses or squared off partitions will not be accepted.
 - 2. Attachment of the interior partitions to the casing shall be by means of an interlocking track assembly. Tracks shall be solid galvanized steel and shall be welded to the outer casing. Attachment of the interior partitions to the tracks shall be such that a minimum of 4 thicknesses of metal exist at this location. The track assembly shall stiffen the exterior casing, provide a reinforced attachment detail for the interior partitions, and shall maintain a uniform airspace width along the length of the silencer for consistent aerodynamic and acoustic performance. Interior partitions shall be additionally secured to the outer casing with welded nose clips at both ends of the sound attenuator.
 - 3. Sound attenuating units shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge from inside to outside the casing. Airtight construction shall be provided by use of a duct sealing compound on the job-site material and labor furnished by the contractor.
- E. Acoustic Performance:
 - 1. All silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E477-99. The test facility shall be NVLAP accredited for the ASTM E477-99 test standard. Data from a non-accredited laboratory will not be acceptable. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for FORWARD FLOW (air and noise in same direction) and REVERSE FLOW (air and noise in opposite directions) with airflow of at least 2000 fpm entering face velocity. Data for rectangular and tubular type silencers shall be presented for tests conducted using silencers no smaller than the following cross-sections:
 - a. Rectangular, inch: 24x24, 24x30, or 24x36.

- b. Tubular, inch: 12, 24, 36, and 48.
- F. Aerodynamic Performance:
- 1. Static pressure loss of silencers shall not exceed 0.05" wg. Airflow measurements shall be made in accordance with ASTM specification E477-99 and applicable portions of ASME, AMCA, and ADC airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented.
- G. Certification:
- 1. With submittals, the manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility, shall utilize the same silencer, and shall be open to inspection upon request from the Architect/Engineer.
- H. Duct Transitions:
- 1. When transitions are required to adapt silencer dimensions to connecting duct work they shall be furnished by the installing contractor.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide 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 on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers and equipment.
 - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
 - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
 - 5. On sides of ducts where adequate clearance is available.
- I. Install the following sizes for duct-mounting, rectangular access doors:
 - 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.
- J. Install the following sizes for duct-mounting, round access doors:
 - 1. One-Hand or Inspection Access: 8 inches in diameter.
 - 2. Two-Hand Access: 10 inches in diameter.
 - 3. Head and Hand Access: 12 inches in diameter.
 - 4. Head and Shoulders Access: 18 inches in diameter.
 - 5. Body Access: 24 inches in diameter.

- K. Label access doors according to Division 23 Section "HVAC System Identification."
 - L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
 - M. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
 - N. Connect flexible ducts to metal ducts with draw bands.
 - O. Install duct test holes where indicated and required for testing and balancing purposes.
- 3.2 ADJUSTING
- A. Adjust duct accessories for proper settings.
 - B. Adjust fire and smoke dampers for proper action.
 - C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 233300

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. In-line centrifugal fans.
 - 2. Centrifugal roof ventilators

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Twin City Fan
 - 4. PennBarry
 - 5. Pre-approved equal.
- B. Description: In-line, direct- or belt-driven, as scheduled, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- C. Housing: Inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor.
- E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- G. Accessories:
 - 1. Companion Flanges: For inlet and outlet duct connections.
 - 2. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 - 3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.2 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
 - 3. Twin City Fan.
 - 4. PennBarry.
 - 5. Pre-approved equal.
- B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- C. Housing: Removable, spun-aluminum, dome top and outlet baffle or upblast as scheduled; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.
- D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
 - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
 - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
 - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
 - 4. Fan and motor isolated from exhaust airstream.
- F. Accessories:
 - 1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
 - 2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 3. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Built-in raised cant and mounting flange.
 - 2. Overall Height: 12 inches.
 - 3. Pitch Mounting: Manufacture curb for roof slope.
 - 4. Metal Liner: Galvanized steel.
 - 5. Mounting Pedestal: Galvanized steel with removable access panel.
 - 6. Vented Curb: Unlined with louvered vents in vertical sides.

2.3 MOTORS

- A. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Support units using elastomeric mounts having a static deflection of 1 inch.
 - 1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch.
- E. Install units with clearances for service and maintenance.
- F. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

- G. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- H. Install ducts adjacent to power ventilators to allow service and maintenance.
- I. Ground equipment according to Section "Grounding and Bonding."
- J. Connect wiring according to Section "Conductors and Cables."
- K. Install units on curbs per manufacturer's installation instructions.

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233416

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling, wall and floor-mounted diffusers, registers, and grilles.

1.2 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GRILLES, DIFFUSERS AND REGISTERS

- A. See schedule on the drawings.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Krueger.
 - b. Nailor Industries of Texas Inc.
 - c. Price Industries.
 - d. Titus.
 - e. Pre-approved equal.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 233813 - COMMERCIAL-KITCHEN HOODS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes Type I commercial kitchen hoods.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Filters/baffles.
 - 2. Fire-suppression systems.
 - 3. Lighting fixtures.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.
 - 2. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
 - 3. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
 - 4. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 5. Wiring Diagrams: Power, signal, and control wiring.
 - 6. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 HOOD MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Minimum Thickness: 0.050 inch
 - 2. Finish: Comply with SSINA's "Finishes for Stainless Steel" for recommendations for applying and designating finishes.
 - a. Finish shall be free from tool and die marks and stretch lines and shall have uniform, directionally textured, polished finish indicated, free of cross scratches. Grain shall run with long dimension of each piece.
 - 3. Concealed Stainless-Steel Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished finish).
 - 4. Exposed Surfaces: ASTM A 480/A 480M, No. 2B finish (bright, cold-rolled, unpolished).
 - 5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Zinc-Coated Steel Shapes: ASTM A 36/A 36M, zinc coated according to ASTM A 123/A 123M requirements.

- C. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Elastomeric sealant shall be NSF certified for commercial kitchen hood application. Sealants, when cured and washed, shall comply with requirements in 21 CFR, Section 177.2600, for use in areas that come in contact with food.
 - 1. Color: As selected by Architect from manufacturer's full range.
 - 2. Backer Rod: Closed-cell polyethylene, in diameter larger than joint width.
- D. Sound Dampening: NSF-certified, nonabsorbent, hard-drying, sound-deadening compound for permanent adhesion to metal in minimum 1/8-inch thickness that does not chip, flake, or blister.
- E. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene, or PVC that is nontoxic, stable, odorless, nonabsorbent, and unaffected by exposure to foods and cleaning compounds, and that passes testing according to UL 710.

2.2 GENERAL HOOD FABRICATION REQUIREMENTS

- A. Welding: Use welding rod of same composition as metal being welded. Use methods that minimize distortion and develop strength and corrosion resistance of base metal. Make ductile welds free of mechanical imperfections such as gas holes, pits, or cracks.
 - 1. Welded Butt Joints: Full-penetration welds for full-joint length. Make joints flat, continuous, and homogenous with sheet metal without relying on straps under seams, filling in with solder, or spot welding.
 - 2. Grind exposed welded joints flush with adjoining material and polish to match adjoining surfaces.
 - 3. Where fasteners are welded to underside of equipment, finish reverse side of weld smooth and flush.
 - 4. Coat concealed stainless-steel welded joints with metallic-based paint to prevent corrosion.
- B. For metal butt joints, comply with SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- C. Form metal with break bends that are not flaky, scaly, or cracked in appearance; where breaks mar uniform surface appearance of material, remove marks by grinding, polishing, and finishing.
- D. Sheared Metal Edges: Finish free of burrs, fins, and irregular projections.
- E. In food zones, as defined in NSF, fabricate surfaces free from exposed fasteners.
- F. Cap exposed fastener threads, including those inside cabinets, with stainless-steel lock washers and stainless-steel cap (acorn) nuts.
- G. Fabricate pipe slots on equipment with turned-up edges sized to accommodate service and utility lines and mechanical connections.
- H. Fabricate enclosures, including panels, housings, and skirts, to conceal service lines, operating components, and mechanical and electrical devices including those inside cabinets, unless otherwise indicated.
- I. Fabricate equipment edges and backsplashes according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines."
- J. Fabricate enclosure panels to ceiling and wall as follows:
 - 1. Fabricate panels on one side with same material as hood, and extend from ceiling to top of hood canopy and from canopy to wall.
 - 2. Wall Offset Spacer: Minimum of 3 inches.
 - 3. Wall Shelves and Overshelves: Fabricate according to SMACNA's "Kitchen Ventilation Systems & Food Service Equipment Guidelines," with minimum 0.0625-inch- thick, stainless-steel shelf tops.

2.3 TYPE I EXHAUST HOOD FABRICATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Captive-Aire Systems.
 - 2. Greenheck.
 - 3. LCSsystems, Inc.
 - 4. Accurex
 - 5. Pre-approved equal.

- B. Weld all joints exposed to grease with continuous welds, and make filters/baffles or grease extractors and makeup air diffusers easily accessible for cleaning.
 - 1. Fabricate hoods according to NSF 2, "Food Equipment."
 - 2. Hoods shall be listed and labeled, according to UL 710, by a testing agency acceptable to authorities having jurisdiction.
 - 3. Hoods shall be designed, fabricated, and installed according to NFPA 96.
 - 4. Include access panels as required for access to fire dampers and fusible links.
 - 5. Duct Collars Without Fire Dampers: Minimum 0.0598-inch thick steel at least 3 inches long, continuously welded to top of hood and at corners.
- C. Hood Configuration: Exhaust and makeup air.
 - 1. Makeup air shall be introduced through front and bottom of canopy through perforated diffusers.
- D. Hood Style: Wall-mounted canopy.
- E. Filters/Baffles: Removable, stainless-steel or aluminum, with spring-loaded fastening. Fabricate stainless steel for filter frame and removable collection cup and pitched trough. Exposed surfaces shall be pitched to drain to collection cup. Filters/baffles shall be tested according to UL 1046, "Grease Filters for Exhaust Ducts," by an NRTL acceptable to authorities having jurisdiction.
- F. Lighting Fixtures: Recessed fixtures and lamps with lenses sealed vaportight. Wiring shall be installed in conduit on hood exterior. Number and location of fixtures shall provide a minimum of 70 fc at 30 inches above finished floor.
 - 1. Light switches shall be mounted on front panel of hood canopy.
 - 2. Lighting Fixtures: Incandescent complying with UL 1598.
- G. Comply with requirements in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" for hood controls.
- H. Hood Controls: Hood-mounting control cabinet, factory wired to control groups of adjacent hoods, and fabricated of stainless steel.
 - 1. Exhaust Fan: On-off switches shall start and stop the exhaust fan. Interlock exhaust fan with makeup air supply fan to operate simultaneously. Interlock exhaust fan with fire-suppression system to operate fan(s) during fire-suppression-agent release and to remain in operation until manually stopped. Include red pilot light to indicate fan operation. Motor starters shall comply with Section 262913 "Enclosed Controllers."
 - 2. Exhaust Fan Interlock: Factory wire the exhaust fan starters in a single control cabinet for adjacent hoods to operate together.
 - 3. High-Temperature Control: Alarm shall sound and cooking equipment shall shut down before hood discharge temperature rises to actuation temperature of fire-suppression system.
- I. Capacities and Characteristics: See schedules on drawings.

2.4 WET-CHEMICAL FIRE-SUPPRESSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ansul Incorporated; a Tyco International Ltd. Company.
 - 2. Badger Fire Protection.
 - 3. Kidde Fire Systems.
 - 4. Pyro Chem.
 - 5. Pre-approved equal.
- B. Description: Engineered distribution piping designed for automatic detection and release or manual release of fire-suppression agent by hood operator. Fire-suppression system shall be listed and labeled for complying with NFPA 17A, "Wet Chemical Extinguishing Systems," by a qualified testing agency acceptable to authorities having jurisdiction.
 - 1. Steel Pipe, NPS 2 and Smaller: ASTM A 53/A 53M, Type S, Grade A, Schedule 40, plain ends.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
 - 3. Piping, fusible links and release mechanism, tank containing the suppression agent, and controls shall be factory installed. Controls shall be in stainless-steel control cabinet mounted on hood. Furnish manual pull station for wall mounting. Exposed piping shall be covered with chrome-plated aluminum tubing. Exposed fittings shall be chrome plated.
 - 4. Liquid Extinguishing Agent: Noncorrosive, low-pH liquid.
 - 5. Furnish electric-operated gas shutoff valve.

6. Furnish electric-operated gas shutoff valve with clearly marked open and closed indicator for field installation.
7. Fire-suppression system controls shall be integrated with controls for fans, lights, and fuel supply and located in a single cabinet for each group of hoods immediately adjacent.
8. Wiring shall have color-coded, numbered terminal blocks and grounding bar. Spare terminals for fire alarm, optional wiring to start fan with fire alarm, red pilot light to indicate fan operation, and control switches shall all be factory wired in control cabinet with relays or starters. Include spare terminals for fire alarm, and wiring to start fan with fire alarm.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Complete field assembly of hoods where required.
 1. Make closed butt and contact joints that do not require filler.
 2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication Requirements" Article.
- B. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- C. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- D. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.
- E. Install hoods to operate free from vibration.
- F. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- G. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- H. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- I. Set initial temperatures, and calibrate sensors.
- J. Set field-adjustable switches.
- K. Connect ducts according to requirements in Section 233300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.
- L. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Perform hood performance tests required by authorities having jurisdiction.

4. Perform fire-suppression system performance tests required by authorities having jurisdiction.

D. Prepare test and inspection reports.

END OF SECTION 233813

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Electric Heating.
 - 3. Economizer outdoor- and return-air damper section.
 - 4. Roof curbs.

1.2 DEFINITIONS

- A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- B. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- D. Supply-Air Fan: The fan providing supply-air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- E. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- F. VVT: Variable-air volume and temperature.

1.3 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.
- B. Warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
 - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.

- B. ASHRAE Compliance:
 1. Comply with ASHRAE 15 for refrigerant system safety.
 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Aeon.
 2. Trane.
 3. Lennox.

2.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 1. Exterior Casing Thickness: 0.0626 inch thick.
- C. Inner Casing Fabrication Requirements:
 1. Inside Casing: Galvanized steel, 0.028 inch thick.
- D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 1. Materials: ASTM C 1071, Type I.
 2. Thickness: 1/2 inch.
 3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
 4. Liner Adhesive: Comply with ASTM C 916, Type I.
- E. Condensate Drain Pans: Formed sections of galvanized-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
 1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
 2. Drain Connections: Threaded nipple.
 3. Pan-Top Surface Coating: Corrosion-resistant compound.

- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

- A. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, VFD rated motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Propeller or forward curved, shaft mounted on permanently lubricated motor.
- D. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

- A. Supply-Air Refrigerant Coil:
 - 1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
 - 3. Coil Split: Interlaced.
 - 4. Condensate Drain Pan: Galvanized steel with corrosion-resistant coating formed with pitch and drain connections complying with ASHRAE 62.1.
- B. Outdoor-Air Refrigerant Coil:
 - 1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.

2.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Compressor: Hermetic, reciprocating or hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- B. Refrigeration Specialties:
 - 1. Refrigerant: R-410A.
 - 2. Expansion valve with replaceable thermostatic element.
 - 3. Refrigerant filter/dryer.
 - 4. Manual-reset high-pressure safety switch.
 - 5. Automatic-reset low-pressure safety switch.
 - 6. Minimum off-time relay.
 - 7. Automatic-reset compressor motor thermal overload.
 - 8. Brass service valves installed in compressor suction and liquid lines.

2.6 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated: Minimum 90 percent arrestance, and MERV 7.

2.7 ELECTRIC-RESISTANCE HEATING:

- A. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- B. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
- C. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
- D. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
 - 1. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.

2. Time-delay relay.
3. Airflow proving switch.

2.8 DAMPERS

- A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper.
- B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
 1. Damper Motor: Modulating with adjustable minimum position.
 2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC."
- B. DDC Controller:
 1. Controller shall have volatile-memory backup.
 2. Safety Control Operation:
 - a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
 - b. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence described in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."
 3. Refer to control sequence on the Drawings.
- C. Interface Requirements for HVAC Instrumentation and Control System:
 1. Interface relay for scheduled operation.
 2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
 3. Provide BACnet compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
 - d. Monitoring occupied and unoccupied operations.

2.11 ACCESSORIES

- A. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.
- B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- D. Coil guards of painted, galvanized-steel wire.
- E. Hail guards of galvanized steel, painted to match casing.
- F. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

2.12 ROOF CURBS

- A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C 1071, Type I or II.
 - b. Thickness: 2 inches.
 - 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C 916, Type I.
- C. Curb Height: 16 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure RTUs to structural support with anchor bolts.
- D. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- E. Install piping adjacent to RTUs to allow service and maintenance.
 - 1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- F. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
 - 4. Install return-air duct continuously through roof structure.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
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.

- D. Remove and replace malfunctioning units and retest as specified above.

3.3 CLEANING AND ADJUSTING

- A. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

END OF SECTION 237413

SECTION 237423.13 - PACKAGED, OUTDOOR, HEATING-ONLY MAKEUP-AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes direct-fired heating and ventilating units.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type and configuration of outdoor, direct-fired heating and ventilating unit.
- B. Shop Drawings: For each type and configuration of outdoor, direct-fired heating and ventilating unit.
 - 1. Include plans, elevations, sections, and mounting 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. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of direct-fired heating and ventilating units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Heat Exchangers: Not less than 10 years from date of Substantial Completion.
 - 2. Warranty Period for all other components: Manufacturer's standard, but not less than 1 year from the Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CaptiveAire Systems.
 - 2. Greenheck Fan Corporation.
 - 3. Accurex.

2.2 SYSTEM DESCRIPTION

- A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, and direct-fired gas burner to be installed exterior to the building.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings:
 - 1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
 - 2. Casing Joints: Sheet metal screws or pop rivets, factory sealed with water-resistant sealant.
 - 3. Factory Finish for Steel and Galvanized-Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating. Final finished color shall be Shermin Williams SW7019 Gauntlet Gray
 - 4. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Configuration: Horizontal unit with bottom discharge for roof-mounting installation.
- C. Cabinet: Aluminized- or galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs. Duct flanges at inlet and outlet. Pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
- D. Outer Casing: 0.0359-inch thick steel with heat-resistant, baked-enamel over-corrosion-resistant-treated surface in color to match fan section. Final finished color shall be Shermin Williams SW7019 Gauntlet Gray
- E. Inner Casing:
 - 1. Burner Section Inner Casing: 0.0299-inch- thick steel.
 - 2. Double-wall casing with inner wall of solid steel. for the following sections:
 - a. Blower section.
 - b. Filter section.
 - c. Mixing box.
 - d. Inlet plenum.
 - e. Discharge plenum.
 - f. Access Doors: Hinged with handles for burner and fan motor assemblies on both sides of unit.
 - 3. Internal Insulation: Fibrous-glass duct lining, neoprene coated, comply with ASTM C 1071, Type II, applied on complete unit.
 - a. Thickness: 2 inches
 - b. Insulation Adhesive: Comply with ASTM C 916, Type I.
 - c. Density: 1.5 lb/cu. ft
 - d. Mechanical Fasteners: Galvanized steel suitable for adhesive, mechanical, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.
- F. Discharge Section: Aluminized-steel assembly with two-position, motorized, parallel-blade dampers with nylon bushings.
 - 1. Pattern: Double deflection.
 - 2. Leakage: Low leakage.
- G. Casing Insulation and Adhesive:
 - 1. Materials: ASTM C 1071, Type I
 - 2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the heating-coil section.
- H. Inspection and Access Panels and Access Doors: Formed and reinforced, single- or double-wall and insulated panels of same materials and thicknesses as casing.

2.4 ACCESSORIES

- A. Coil guards of painted, galvanized-steel wire.
- B. Hail guards of galvanized steel, painted to match casing.

2.5 OUTDOOR-AIR INTAKE HOOD

- A. Type: Manufacturer's standard hood or louver.
- B. Materials: Match cabinet. Final finished color shall be Shermin Williams SW7019 Gauntlet Gray
- C. Bird Screen: Comply with requirements in ASHRAE 62.1.
- D. Filter: Aluminum, 2 inches cleanable.
- E. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.6 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 2. Thickness 1-1/2 inches
 - 3. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C 916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C 916, Type I.

- B. Curb Height: 24 inches

2.7 SUPPLY-AIR FAN

- A. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, self-aligning, permanently lubricated ball bearings. Bearing rating: L10 of 120,000 hours
- B. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.
- C. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with spring isolators.
- D. Fan-Shaft Lubrication Lines: Extended to a location outside the casing.

2.8 AIR FILTERS

- A. Comply with NFPA 90A
- B. Cleanable Filters: Cleanable stainless steel metal mesh.
 - 1. Thickness: 2 inches

2.9 DAMPERS

- A. Outdoor-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at a differential pressure of 2-inch wg.
- B. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.

2.10 ELECTRIC-RESISTANCE HEATING:

- A. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in

galvanized-steel frame. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

- B. Overtemperature Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box.
- C. Overcurrent Protection: Manual-reset thermal cutouts, factory wired in each heater stage.
- D. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
 - 1. SCR Controller: Pilot lights operate on load ratio, a minimum of five steps.
 - 2. Time-delay relay.
 - 3. Airflow proving switch.

2.11 CONTROLS

- A. Comply with requirements in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" for control equipment and sequence of operation.
- B. Control Devices:
 - 1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - 2. Fire-Protection Thermostats: Fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature.
 - 3. Ionization-Type Smoke Detectors: 24-V dc, nominal; self-restoring; plug-in arrangement; integral visual-indicating light; sensitivity that can be tested and adjusted in place after installation; integral addressable module; remote controllability; responsive to both visible and invisible products of combustion; self-compensating for changes in environmental conditions.
- C. Fan Control: Interlock fan to start with exhaust fan(s) to which this heating and ventilating unit is associated for makeup air.
- D. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
- E. Temperature Control: Operates gas valve to maintain supply-air temperature.
 - 1. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in blower outlet.
 - 2. DELETED
 - 3. Burner Control: Two or four steps of control using one or two burner sections in series.

2.12 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Enclosure: Totally enclosed, air over
 - 2. Enclosure Materials: Cast aluminum
 - 3. Efficiency: Premium efficient

2.13 CAPACITIES AND CHARACTERISTICS

- A. Fan: As scheduled on drawings.
- B. Fan Motor: As scheduled on drawings.
- C. Single-Point Electrical Connection: As scheduled on drawings.
- D. Heating: As scheduled on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:

- B. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."
- C. Install controls and equipment shipped by manufacturer for field installation with direct-fired heating and ventilating units.
- D. Roof Curb: Install on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- E. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Gas Piping: Comply with requirements in Section 231123 "Facility Natural-Gas Piping.". Connect gas piping with shutoff valve and union, and with sufficient clearance for burner removal and service. Make final connections of gas piping to unit with corrugated, stainless-steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections.
- B. Drain: Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for traps and accessories on piping connections to condensate drain pans under condensing heat exchangers. Where installing piping adjacent to heating and ventilating units, allow space for service and maintenance.
- C. Duct Connections: Connect supply ducts to direct-fired heating and ventilating units with flexible duct connectors. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heating and ventilating units.

END OF SECTION 237423.13

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceways and cables.
 - 2. Sleeve seals.
 - 3. Grout.
 - 4. Common electrical installation requirements.

1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Building wires and cables rated 600 V and less.
 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- 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. Alcan Products Corporation; Alcan Cable Division.
 2. Alpha Wire.
 3. Belden Inc.
 4. Encore Wire Corporation.
 5. General Cable Technologies Corporation.
 6. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658. Aluminum conductors allowed by Alternate only for feeders larger than 100A.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2 and Type SO.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC and Type SO with ground wire.

2.2 CONNECTORS AND SPLICES

- 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, Inc.
 2. Gardner Bender.
 3. Hubbell Power Systems, Inc.
 4. Ideal Industries, Inc.
 5. IlSCO; a branch of Bardes Corporation.
 6. NSi Industries LLC.
 7. O-Z/Gedney; a brand of the EGS Electrical Group.
 8. 3M; Electrical Markets Division.

9. Tyco Electronics.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 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 NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Aluminum conductors allowed by Alternate only for feeders larger than 100A. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway. Metal-clad cable not allowed in these locations.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground:
 - 1. Kitchen area, between devices concealed within walls and at panelboard locations to above accessible ceiling space: Type THHN-THWN, single conductors in raceway,
 - 2. Home runs (not in kitchen area): Metal-clad cable, Type MC.
- E. Branch Circuits Concealed above accessible ceilings, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway or metal-clad cable, Type MC.
- F. Branch Circuits Concealed in Walls and Partitions as well as exposed in kitchens: Type THHN-2-THWN-2, single conductors in raceway. Metal-clad cable not allowed in these locations.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "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 260529 "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.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "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 260544 "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 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Perform the following 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. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report 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.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
 - 1. Overhead-line grounding.
 - 2. Underground distribution grounding.
 - 3. Ground bonding common with lightning protection system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
- B. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NETA MTS.
 - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- 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 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch 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.

- C. 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. Lexan or PVC, impulse tested at 5000 V. See details on Drawings for additional information.

2.2 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. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 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 where indicated on plans.
 1. Install bus on insulated spacers 2 inches minimum from wall, 8'-0" above finished floor unless otherwise indicated.

- 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 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.

- B. 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.
- C. 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.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- 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, wiring closet, and central equipment location.
 - 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.
- F. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 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 Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install 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.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; 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.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Ufer Ground (Concrete-Encased Grounding Electrode): 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.

3.4 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 - 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. 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, at ground test wells, 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.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. 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 ohm(s).
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 1. Hangers and supports for electrical equipment and systems.
 2. Construction requirements for concrete bases.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 1. Steel slotted support systems.
 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 1. Trapeze hangers. Include Product Data for components.
 2. Steel slotted channel systems. Include Product Data for components.
 3. Nonmetallic slotted channel systems. Include Product Data for components.
 4. Equipment supports.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

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. 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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
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. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. 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) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. 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) Cooper B-Line, Inc.; a division of Cooper Industries.

- 2) Empire Tool and Manufacturing Co., Inc.
- 3) Hilti Inc.
- 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
- 5) MKT Fastening, LLC.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 2 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Metal conduits, tubing, and fittings.
 2. Nonmetal conduits, tubing, and fittings.
 3. Metal wireways and auxiliary gutters.
 4. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. LEED Submittals:
 1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
 2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.

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. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Anamet Electrical, Inc.
 4. Electri-Flex Company.
 5. O-Z/Gedney; a brand of EGS Electrical Group.
 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
 7. Republic Conduit.
 8. Robroy Industries.
 9. Southwire Company.
 10. Thomas & Betts Corporation.
 11. Western Tube and Conduit Corporation.
 12. Wheatland Tube Company; a division of John Maneely Company.

- 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. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Die cast.
 - b. Type: Setscrew or compression.
 - 3. 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.
 - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- K. 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, Inc.
 - 2. Anamet Electrical, Inc.
 - 3. Arnco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.
 - 6. Condux International, Inc.
 - 7. Electri-Flex Company.
 - 8. Kraloy.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Niedax-Kleinhuis USA, Inc.
 - 11. RACO; a Hubbell company.
 - 12. Thomas & Betts Corporation.
- 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. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

- H. Fittings for LFNC: Comply with UL 514B.
- I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 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. Cooper B-Line, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Mono-Systems, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 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. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a Pentair company.
 - 7. Hubbell Incorporated; Killark Division.
 - 8. Kraloy.
 - 9. Milbank Manufacturing Co.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. RACO; a Hubbell Company.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- 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. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- F. 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.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- J. Gangable boxes are allowed.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
 - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: EMT.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried, unless otherwise noted on Plans.
 - 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. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Receiving.
 - b. Gymnasiums.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and 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, cast-metal 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. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. 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 260529 "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 four 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. Not allowed.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. 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.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. 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.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. 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.

- R. 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.
- S. 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.
- T. 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 conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. 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 and EMT 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. Indoor Spaces Connected with Outdoors without Physical Separation: 125 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 0.00078 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.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, 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.
- X. 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 top of box unless otherwise indicated.
- Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Z. Horizontally separate boxes mounted on opposite sides of all walls so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. 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.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set metal floor boxes level and flush with finished floor surface.

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 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 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 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. 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.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. 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. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. 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. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, 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: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, 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. Presealed Systems.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, 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.
 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

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 079200 "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 steel 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.

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 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 1. Identification for raceways.
 2. Identification of power and control cables.
 3. Identification for conductors.
 4. Underground-line warning tape.
 5. Warning labels and signs.
 6. Instruction signs.
 7. Equipment identification labels.
 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI 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. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical, telephone and cable utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 4. Tape shall be 6" wide, 4 mils thick, and have metallic core for detection above grade.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE, TELEPHONE CABLE, CATV CABLE, as required by location.

2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.

- B. Baked-Enamel Warning 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.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.9 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 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, Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 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, self locking.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F.
 5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. 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 identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.

- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.
- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. 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.
 - c. UPS.

- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- L. 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.

- M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be laminated acrylic or melamine label and shall state the panelboard identification (as labeled on the panel schedule) and what equipment the panelboard is fed from.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchboards.
 - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - f. Emergency system boxes and enclosures.
 - g. Enclosed switches.
 - h. Enclosed circuit breakers.
 - i. Enclosed controllers.
 - j. Variable-speed controllers.
 - k. Push-button stations.
 - l. Power transfer equipment.
 - m. Contactors.
 - n. Remote-controlled switches, dimmer modules, and control devices.
 - o. Power-generating units.
 - p. Monitoring and control equipment.
 - q. UPS equipment.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Indoor occupancy sensors.
 - 2. Lighting contactors.

1.2 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
 - 2. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Industries, Inc.
 - 2. Intermatic, Inc.
 - 3. Invensys Controls.
 - 4. Leviton Manufacturing Co., Inc.
 - 5. NSi Industries LLC.
 - 6. Tyco Electronics.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Contact Configuration: SPST.
 - 3. Contact Rating: 20-A ballast load, 120-/240-V ac.
 - 4. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
 - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 - 6. Astronomic Time: All channels.
 - 7. Automatic daylight savings time changeover.
 - 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Industries, Inc.
 - 2. Hubbell Building Automation, Inc.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Lightolier Controls.
 - 5. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 6. Lutron Electronics Co., Inc.
 - 7. Sensor Switch, Inc.
 - 8. Square D.
 - 9. Watt Stopper.

- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
 - 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 - 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 5. 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.
 - 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
 - 1. 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..
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy .
 - 1. Detector Sensitivity: 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.
- E. Dual-Technology Type: 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.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Industries, Inc.
 - 2. Hubbell Building Automation, Inc.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Lightolier Controls.
 - 5. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - 6. Lutron Electronics Co., Inc.
 - 7. Sensor Switch, Inc.
 - 8. Square D.
 - 9. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, 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. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 - 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

2.4 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allen-Bradley/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a business of Emerson Network Power.
 - 3. Eaton Corporation.
 - 4. General Electric Company.
 - 5. Square D.

- B. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.
 - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
- C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.
 - 1. Monitoring: On-off status.
 - 2. Control: On-off operation.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG.
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

- A. Wiring Method: Minimum conduit size is 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring.
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 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 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 260943 - RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Lighting control panels using mechanically held relays for switching.

1.2 DEFINITIONS

- A. BAS: Building automation system.
- B. DDC: Direct digital control.
- C. IP: Internet protocol.
- D. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for 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: For each relay panel and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail wiring partition configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of relays.
 - 5. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
 - 6. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

1.4 INFORMATIONAL SUBMITTALS

- A. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls 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 USB drive.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Testing and adjusting of panic and emergency power features.

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. Lighting Control Relays: Equal to 10 percent of amount installed, but no fewer than 10.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation according to NECA 407.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of standalone multipreset modular dimming controls that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
 - 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.
- B. Interface with HVAC DDC System: Hardware and software shall interface with HVAC DDC system to monitor, control, display, and record data for use in processing reports.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status.
 - b. Control: On-off operation.
 - 2. Communication Interface: Comply with ASHRAE 135. The communication interface shall enable the HVAC DDC system operator to remotely control and monitor lighting from a HVAC DDC system operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the HVAC DDC system.
- C. 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. 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.
- E. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- F. Comply with UL 916.

2.2 NETWORKED LIGHTING CONTROL PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crestron.
 - 2. Wattstopper.
 - 3. Lithonia, Acuity Brands Lighting.
- B. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels shall be capable of being interconnected with digital communications to appear to the operator as a single lighting control system.
- C. Lighting Control Panels:
 - 1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 - 2. A vertical barrier separating branch circuits from control wiring.

- D. Main Control Unit: Installed in the main lighting control panel only; powered from the branch circuit of the standard control unit.
1. Ethernet Communications: Comply with TCP/IP protocol. The main control unit shall provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
 2. Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device.
 3. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.
 - a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
 - b. Panel summary showing the master and slave panels connected to the controller.
 - c. Controller diagnostic information.
 - d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens shall also allow direct breaker control and zone overrides.
 4. Timing Unit:
 - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Four independent schedules, each having 24 time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. 16 special date periods.
 5. Time Synchronization: The timing unit shall be updated not less than every 24 hour(s) with the network time server.
 6. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blinking warning" shall warn occupants approximately five minutes before actuating the off sequence.
 - e. Activity log, storing previous relay operation, including the time and cause of the change of status.
 - f. Download firmware to the latest version offered by manufacturer.
- E. Standard Control Unit, Installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916.
1. Electronic control for operating and monitoring individual relays, and display relay on-time.
 2. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
 3. Integral keypad and digital-display front panel for local setup, including the following:
 - a. Blink notice, time adjustable from software.
 - b. Ability to log and display relay on-time.
 - c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.
- F. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-V tungsten, 30 A at 277-V ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit current rating shall be not less than 14 kA. Control shall be digital control network.
- G. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and low-voltage photo sensors.
- H. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring all networked lighting control panels using setup software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device shall remain the property of Owner.
- I. Software:

1. Menu-driven data entry.
2. Online and offline programming and editing.
3. Provide for entry of the room or space designation for the load side of each relay.
4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
5. Size the software appropriate to the system.

2.3 MANUAL SWITCHES AND PLATES

- A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
 1. Integral LED pilot light to indicate when circuit is on.
- B. Wall Plates: Single and multigang plates.
- C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.4 FIELD-MOUNTED SIGNAL SOURCES

- A. Daylight Harvesting Switching Controls: Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.
- B. Indoor Occupancy Sensors: Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG.
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG.
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG.
- D. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors. Comply with requirements in TIA/EIA-568-C.2, Category 6 for horizontal copper cable.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels according to NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 1. Install plenum cable in environmental airspaces, including plenum ceilings.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 PANEL INSTALLATION

- A. Comply with NECA 1.
- B. Install panels and accessories according to NECA 407.
- C. Mount panel cabinet plumb and rigid without distortion of box.
- D. Install filler plates in unused spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate.

3.5 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. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers described below and low-voltage surge arrestors. Certify compliance with manufacturer's test parameters.
 - a. Circuit-Breaker Tests:
 - 1) Compare nameplate with Drawings and Specifications.
 - 2) Inspect physical and mechanical conditions.
 - 3) Inspect anchorage and alignment.
 - 4) Verify that the units are clean.
 - 5) Operate the circuit breaker to ensure smooth operation.
 - 6) Inspect operating mechanism, contacts, and arc chutes in unsealed units.
 - 7) Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset trip logs and indicators.
 - b. Surge Arrestor Tests:
 - 1) Compare nameplate with the Contract Documents.
 - 2) Inspect physical and mechanical conditions.
 - 3) Inspect anchorage, alignment, grounding, and clearances.
 - 4) Verify that the units are clean.
 - 5) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Lighting control panel will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 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.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION 260943

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Service and distribution switchboards rated 600 V and less.
 - 2. Transient voltage suppression devices.
 - 3. Disconnecting and overcurrent protective devices.
 - 4. Instrumentation.
 - 5. Control power.
 - 6. Accessory components and features.
 - 7. Identification.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each switchboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards.
 - 3. Include schematic and wiring diagrams for power, signal, and control wiring.
- C. Field quality-control reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 2.
- C. Comply with NFPA 70.
- D. Comply with UL 891.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
 - 5. Pre-approved equal.
- B. Front-Connected, Front-Accessible Switchboards:
 - 1. Main Devices: Fixed, individually mounted.

2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- C. Enclosure: Steel, NEMA 250, Type 1 unless noted otherwise.
1. Enclosure Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
 2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.
- D. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- E. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- F. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- G. Phase and Neutral Buses and Connections: Three phase, four wire unless otherwise indicated. Hard-drawn copper of 98 percent conductivity with copper circuit-breaker line connections.
1. Ground Bus: 1/4-by-2-inch-minimum size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors.
 2. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
 3. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables.
- H. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:
1. Fuses, rated at 200-kA interrupting capacity.
 2. LED indicator lights for power and protection status.
 3. Audible alarm, with silencing switch, to indicate when protection has failed.
 4. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device.
 5. Transient-event counter set to totalize transient surges.
- B. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.
- C. Withstand Capabilities: 5000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
- D. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 or 208Y/120-V, three-phase, four-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277; 400 V for 208Y/120.
 2. Line to Ground: 800 V for 480Y/277; 400 V for 208Y/120.
 3. Neutral to Ground: 800 V for 480Y/277; 400 V for 208Y/120.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

- a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Where indicated, Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
- a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Where indicated, Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
- B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
- 1. Fixed circuit-breaker mounting.
 - 2. Two-step, stored-energy closing.
 - 3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time time adjustments.
 - c. Where indicated, Ground-fault pickup level, time delay, and I^2t response.

2.4 INSTRUMENTATION

- A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
- 1. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 - 2. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
 - 3. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
- 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 1 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
 - d. Megawatts: Plus or minus 2 percent.
 - e. Megavars: Plus or minus 2 percent.
 - f. Power Factor: Plus or minus 2 percent.
 - g. Frequency: Plus or minus 0.5 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
 - 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
 - 3. Provide connection to Building Management System via BacNet protocol, coordinate with controls contractor.

2.5 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.7 IDENTIFICATION

- A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install switchboards and accessories according to NECA 400.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to switchboards.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
- D. Install filler plates in unused spaces of panel-mounted sections.
- E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Comply with NECA 1.
- G. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Switchboard will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
- C. Field quality-control reports.
- D. Panelboard schedules for installation in panelboards.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Directory Card: Typed schedule depicting "as-built" circuit descriptions, inside panelboard door, mounted in transparent card holder.

- B. Incoming Mains Location: Top or bottom as required by project conditions.
- C. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- D. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Pre-approved equal.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Pre-approved equal.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Pre-approved equal.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.

- c. Long- and short-time time adjustments.
- d. Ground-fault pickup level, time delay, and I^2t 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 two-pole configurations with Class A ground-fault protection (6-mA trip).
- 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

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. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.
- B. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. 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.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 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 stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

- D. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 2. Wall-box motion sensors.
 3. Snap switches and wall-box dimmers.
 4. Solid-state fan speed controls.
 5. Wall-switch and exterior occupancy sensors.
 6. Communications outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
 5. Pre-approved equal.

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).
 - e. Pre-approved equal.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

- c. Pre-approved equal.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
 - e. Pre-approved equal.
- C. Pilot Light Switches, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - e. Pre-approved equal.
 - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 - e. Pre-approved equal.
 - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.
 - e. Pre-approved equal.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.
 - e. Pre-approved equal.

2.5 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable toggle switch; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. Dimmers shall be rated for load served. Coordinate with specific applications indicated on the Drawings.

- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 - 1. Continuously adjustable toggle switch.
 - 2. Three-speed adjustable rotary knob, 1.5 A.

2.7 OCCUPANCY SENSORS

- A. Provide occupancy sensors as noted on Drawings. Provide all power packs and accessories for a complete and operable lighting control system as required to support sensors and control devices indicated on Drawings.

2.8 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished 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 locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.9 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Essential Power System: Red.
 - 3. Wiring Devices Connected to Shielded Power System: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

- D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. 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.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Cartridge fuses rated 600-V ac and less for use in switches and enclosed controllers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA FU 1 for cartridge fuses.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cooper Bussmann, Inc.
 2. Edison Fuse, Inc.
 3. Ferraz Shawmut, Inc.
 4. Littelfuse, Inc.
 5. Pre-approved equal.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

- A. Feeders: Class L, time delay or Class J, time delay.
- B. Motor Branch Circuits: Class J, time delay.
- C. Other Branch Circuits: Class J, time delay.

3.2 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Molded-case circuit breakers.

1.3 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Manufacturers:
 - 1. Field verify and match existing panelboard manufacturer.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- C. Molded-Case Circuit-Breaker Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 4. Ground-Fault Protection: integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

3.3 IDENTIFICATION

- A. Update existing panelboard schedule accordingly.

3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
 - 1. Inspect mechanical and electrical connections.
 - 2. Verify switch and relay type and labeling verification.
 - 3. Verify rating of installed fuses.

3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 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 and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project, IES LM-79, and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire 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.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- D. Product Certificates: For each type of luminaire.
- E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 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 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE 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. Recessed Fixtures: Comply with NEMA LE 4.
- C. CRI of 80 (minimum). CCT of 4000 K unless otherwise indicated.
- D. Rated lamp life of 50,000 (minimum) hours.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.

2.2 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: 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.
- C. Diffusers and Globes:
 - 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "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 luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment 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 fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- D. Install lamps in each luminaire.
- E. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.
- F. 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 vertical force of 400 percent of luminaire weight.
- G. Ceiling-Grid-Mounted Luminaire Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.
 - 2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
 - 3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. Install at least one independent support rod or wire from structure to a tab on luminaire. Wire or rod shall have breaking strength of the luminaire weight at a safety factor of 3.

- H. Flush-Mounted Luminaire Support:
 - 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.
- I. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- J. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 - 4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "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.

3.5 ADJUSTING

- A. Occupancy Adjustments: Provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Some of this work may be required during hours of darkness.
 - 1. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Emergency lighting units.
 - 2. Exit signs.
 - 3. Luminaire supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external 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.

1.4 SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Product Schedule:
 - 1. For emergency lighting units. Use same designations indicated on Drawings.
 - 2. For exit signs. Use same designations indicated on Drawings.
- C. Product Certificates: For each type of luminaire.
- D. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems 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 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.7 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.

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 fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.
- G. Bulb Shape: Complying with ANSI C79.1.

2.2 EMERGENCY LUMINAIRES

- A. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
 - 1. Emergency Connection: Operate lamp(s) continuously at an output of 1100 (minimum) lumens upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast or driver.
 - 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, nickel-cadmium type.
 - 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 - 6. Integral Self-Test (When Specified on Drawings): Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
 - 1. Emergency Connection: Operate fluorescent or LED lamp(s) continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast or driver.
 - 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. Battery: Sealed, maintenance-free, nickel-cadmium type.

4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the ballast, driver, or emergency power unit manufacturer, whichever is less.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test (When Specified on Drawings): Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Lighting Unit:
 1. Operating at nominal voltage of 120 V ac or 277 V ac.
 2. Wall or ceiling with universal junction box adaptor.
 3. UV stable thermoplastic housing.
 4. Two Halogen or LED lamp heads.
 5. Internal emergency power unit.
- C. Remote Emergency Lighting Units:
 1. Operating at nominal voltage of 120 V ac, 277 V ac, 6 V dc, 9.6 V dc, 12 V dc, or 24 V dc.
 2. Wall or ceiling with universal junction box adaptor.
 3. Steel housing rated for wet locations.
 4. Two Halogen or LED lamp heads.
 5. External emergency power unit.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Operating at nominal voltage of 120 V ac or 277 V ac.
 2. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.5 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

- B. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- 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. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- E. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
- F. 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.
 - 3. Use approved devices and support components to connect luminaire to ceiling grid.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 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.

END OF SECTION 265219

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
 - 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 and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project, IES LM-79, and IES LM-80.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire 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.
- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- D. Product Certificates: For each type of luminaire.
- E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 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 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE 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. Recessed Fixtures: Comply with NEMA LE 4.
- C. CRI of 80 (minimum). CCT of 2700 K unless otherwise indicated.
- D. LEDs shall have a minimum L70 at 50,000 hours based on TM-21 Addendum-A lifetime report data.
- E. Internal driver or as listed in fixture schedule.
- F. Batteries in fixtures designated for emergency lighting must be compatible with the emergency unit used with minimum leakage.

2.2 DIMMING REQUIREMENTS

- A. LEDs dimmable from 100 percent to 5 percent of maximum light output, unless noted otherwise in the light fixture schedule.
- B. All LED dimming shall be smooth and free of flickering. Contractor shall coordinate between dimmer manufacturers, light fixture manufacturers, driver manufacturers, and lamp manufacturers as required in order to install a completely flicker free dimming system.

2.3 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: Smooth operating, free of light leakage under operating conditions, and designed to permit LED or driver access without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position.

- C. Diffusers and Globes:
 1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 2. Glass: Annealed crystal glass unless otherwise indicated.
 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Housings:
 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 2. Provide filter/breather for enclosed luminaires.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

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 fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Remote Mounting of drivers: Distance between the driver and luminaire shall not exceed that recommended by the fixture manufacturer. Verify, with manufacturer, maximum distance between driver and luminaire.
- C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- D. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.
- E. 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 vertical force of 400 percent of luminaire weight.
- F. Flush-Mounted Luminaire Support:
 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.

G. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.

- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "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.

3.5 ADJUSTING

- A. Occupancy Adjustments: Provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Some of this work may be required during hours of darkness.

1. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for pathways and cables.
 - 2. Sleeve seals.
 - 3. Grout.
 - 4. Common communications installation requirements.

1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of pathway or cable.
 - 3. Pressure Plates: Plastic. Include two for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS 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. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.
 - 2. Ground and roof rings.
 - 3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For Installer, installation supervisor, and field inspector.
- C. Field quality-control reports.

1.6 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 017823 "Operation and Maintenance Data," include the following:
 - a. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.
 - c. .

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as a registered communications distribution designer to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

2.2 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Harger Lightning & Grounding.
 - 2. Panduit Corp.
 - 3. TE Connectivity Ltd.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
 - 3. <Double click to insert sustainable design text for lead content.>
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. 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 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Chatsworth Products, Inc.
 - 3. Harger Lightning & Grounding.
 - 4. Panduit Corp.
 - 5. TE Connectivity Ltd.
- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

E. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.
2. Harger Lightning & Grounding.
3. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, ¼ inch thick by 4 inches wide by 29 inches long. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

2.5 GROUND RODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Harger Lightning & Grounding.
2. TE Connectivity Ltd.

B. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

2.6 LABELING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brother International Corporation.
2. HellermannTyton.
3. Panduit Corp.

B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-A.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 3/0 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 3/0 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- C. 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.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

- B. 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.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Bond the equipment grounding busbar to the TGB No. 6 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.
- I. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- J. Access Floors: Bond all metal parts of access floors to the TGB.
- K. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- L. Towers and Antennas:
 - 1. Ground Ring: Buried at least 30 inches below grade and at least 24 inches from the base of the tower or mounting.
 - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches below grade.
 - 3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches below grade.
 - 4. Bond metallic fences within 6 feet of towers and antennas to the ground ring, buried at least 18 inches below grade.
 - 5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.

6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS 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. Metal conduits and fittings.
 2. Nonmetallic conduits and fittings.
 3. Optical-fiber-cable pathways and fittings.
 4. Metal wireways and auxiliary gutters.
 5. Nonmetallic wireways and auxiliary gutters.
 6. Surface pathways.
 7. Boxes, enclosures, and cabinets.
 8. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
 2. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Samples: For wireways and for each color and texture specified, 12 inches long.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 1. Structural members in paths of pathway groups with common supports.
 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements:
 1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Alpha Wire Company.

4. Anamet Electrical, Inc.
 5. Electri-Flex Company.
 6. O-Z/Gedney; a brand of EGS Electrical Group.
 7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.
 8. Republic Conduit.
 9. Robroy Industries.
 10. Southwire Company.
 11. Thomas & Betts Corporation.
 12. Western Tube and Conduit Corporation.
 13. Wheatland Tube Company; a division of John Maneely Company.
- B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- G. EMT: Comply with ANSI C80.3 and UL 797.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. 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 AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements:
1. AFC Cable Systems, Inc.
 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 3. Anamet Electrical, Inc.
 4. Arnco Corporation.
 5. CANTEX Inc.
 6. CertainTeed Corp.
 7. Condux International, Inc.
 8. Electri-Flex Company.
 9. Kraloy.
 10. Lamson & Sessions; Carlon Electrical Products.
 11. Niedax-Kleinhuis USA, Inc.
 12. RACO; a Hubbell company.
 13. Thomas & Betts Corporation.
- B. General Requirements for Nonmetallic Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.

- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Rigid HDPE: Comply with UL 651A.
- E. Continuous HDPE: Comply with UL 651B.
- F. RTRC: Comply with UL 1684A and NEMA TC 14.
- G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements:
 1. Cooper B-Line, Inc.
 2. Hoffman; a Pentair company.
 3. Mono-Systems, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 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.
 2. Comply with TIA-569-B.
- 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:
 1. Adalet.
 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 3. EGS/Appleton Electric.
 4. Erickson Electrical Equipment Company.
 5. Hoffman; a Pentair company.
 6. Hubbell Incorporated; Killark Division.
 7. Lamson & Sessions; Carlon Electrical Products.
 8. Milbank Manufacturing Co.
 9. Molex; Woodhead Brand.
 10. Mono-Systems, Inc.
 11. O-Z/Gedney; a brand of EGS Electrical Group.
 12. RACO; a Hubbell company.
 13. Robroy Industries.
 14. Spring City Electrical Manufacturing Company.
 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 16. Thomas & Betts Corporation.
 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
 1. Comply with TIA-569-B.
 2. 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. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, round.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- K. Gangable boxes are allowed.
- L. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures:
 - a. Material: Plastic.
 - b. Finished inside with radio-frequency-resistant paint.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC
 - 2. Concealed Conduit, Aboveground: GRC
 - 3. Underground Conduit: RNC, Type EPC-40-PVC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply pathway 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. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

- c. Mechanical rooms.
- d. Gymnasiums
- 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
- 5. Damp or Wet Locations: GRC.
- 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
- 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway.
- 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway.
- 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size.

D. Pathway Fittings: Compatible with pathways 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.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "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 two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

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. Pathways 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 pathways to reinforcement at maximum 10-foot intervals.
- 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
- 3. Arrange pathways to keep a minimum of 1 inch of concrete cover in all directions.
- 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to RNC, Type EPC-40-PVC, before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 1. Use EMT, IMC, or RMC for pathways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways 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 of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:
 1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 2. Install surface pathway with a minimum 2-inch radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Pathways for Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway sealing fittings according to NFPA 70.
- U. Install devices to seal pathway 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 pathways at the following points:
 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. 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 and EMT 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. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. 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.
- X. 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.
 - Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
 - Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - AA. 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.
 - BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - CC. Set metal floor boxes level and flush with finished floor surface.
 - DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
- 3.4 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- 3.5 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage or 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 270528

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Telecommunications service entrance pathways.
 - 2. Backboards.
 - 3. Grounding.
 - 4. Telecommunications equipment frame racks and cabinets.
 - 5. Labeling

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies, and location and size of each field connection.
 - 2. Equipment racks and cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of Commercial Installer, Level 2.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.5 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2. Record agreements reached in meetings and distribute them to other participants.
 - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 - 3. Lacing bars, spools, J-hooks, and D-rings.
 - 4. Straps and other devices.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep.
- C. Velcro Cable Ties
 - 1. Provide Velcro cable ties, plenum or non-plenum rated as appropriate for the installation, in the same color as the cable to which it is being applied, 18-mm (¾-inch) with a minimum 50-mm (2-inch) overlap.
 - 2. Manufacturers:
 - a. Panduit HLSP Series (Plenum rated)
 - b. Panduit HLS Series (Non-plenum rated).

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.3 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

2.4 EQUIPMENT FRAME RACKS

- A. Manufacturers: Four-post rack (MDF)
 - 1. Chatsworth CPI: Model 15254-703
 - 2. Hoffman: Model E4DRS19FM45U
 - 3. Hubbell Premise: Model H1KR84
 - 4. Panduit: Model R4PCN
- B. Provide LAN equipment racks from one manufacturer.
- C. Provide LAN equipment racks conforming to TIA/EIA standards with the following features and characteristics and accessories:
 - 1. 19-inch wide, 84" high, two-post and four-post, as indicated, high strength aluminum construction, EIA – 310-D.
 - 2. Loading capacity: 1,400 pounds (635 kg).
 - 3. 19" rack mounting rails with TIA/EIA hole pattern.
 - a. Round punched holes for the two-post vertical rails.
 - b. Square punched holes for the four-post vertical rails.
 - 4. Floor mounting hardware.
 - 5. Equipment mounting hardware: 20 sets for each rack.

6. Vertical cable management with front and rear access.
7. Horizontal cable management, top and bottom.
8. Equipment shelves: None.
9. Grounding lug.
10. Baked-polyester powder coat finish, black.

2.5 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.
- C. Comply with NECA 1.
- D. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- E. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- F. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- E. Equipment Frames:
 1. Provide all components of the cabinet system (including any optional accessories).
 2. Install and adjust to position all cabinet components including accessories. Install vertical cable managers, power distribution and equipment-mounting rails, using the manufacturer's installation instructions prior to buying and/or placing the cabinet for attachment to the building and before installing any rack-mount equipment into the cabinet. Shelves, horizontal cable managers and filler panels, if used, may be installed after the cabinet is placed.
 3. Attach securely to the structural floor in accordance with the manufacturer's installation instructions. When attached to the structural floor, the installer shall provide installation hardware.
 4. Attach overhead ladder rack to the top of the cabinet. The ladder rack/cable tray shall be positioned so that it does not interfere with the hot air exhaust through the cabinet's top panel.

5. Cabinets shall be securely bonded to a common ground. Attach a bonding conductor sized as defined in J-STD-607-A and as defined by local code or the authority having jurisdiction (AHJ) between the common ground and the cabinet. Attach the bonding conductor to the cabinet using a ground terminal block according to the manufacturer's installation instructions. The installer shall provide the bonding conductor and other necessary hardware required to make the connections between the cabinet and the common ground.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

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 260544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems"

B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Fire-alarm control unit.
 2. Manual fire-alarm boxes.
 3. System smoke detectors.
 4. Heat detectors.
 5. Notification appliances.
 6. Remote annunciator.
 7. Addressable interface device.
 8. Digital alarm communicator transmitter.

1.2 SYSTEM DESCRIPTION

- A. Noncoded, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.3 SUBMITTALS

- A. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level III minimum.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 2. Include voltage drop calculations for notification appliance circuits.
 3. Include battery-size calculations.
 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- D. Delegated-Design Submittal: For smoke and heat detectors 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. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
- E. Qualification Data: For qualified Installer.
- F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
- G. Field quality-control reports.

- H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. 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.
 7. Copy of NFPA 25.

- I. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing 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.

1.5 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.

- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Simplex.
 2. Notifier.
 3. Edwards Signaling.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 1. Manual stations.
 2. Heat detectors.

3. Smoke detectors.
4. Duct smoke detectors.
5. Automatic sprinkler system water flow.
6. Heat detectors in elevator shaft and pit.
7. Fire-extinguishing system operation.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm-notification appliances.
2. Identify alarm at the fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Recall elevators to primary or alternate recall floors.
8. Activate emergency lighting control.
9. Activate emergency shutoffs for gas and fuel supplies.
10. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators.

2.3 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. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" 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 shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches above the finished floor. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."
 - 1. Install seismic bracing. Comply with requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. 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.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
 - 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
 - 2. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
- E. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches below the ceiling.
- G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
 - 2. Alarm-initiating connection to elevator recall system and components.
 - 3. Alarm-initiating connection to activate emergency lighting control.
 - 4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 5. Supervisory connections at valve supervisory switches.
 - 6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 7. Supervisory connections at elevator shunt trip breaker.
 - 8. Alarm-initiating connection to kitchen hood fire extinguishing system.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.

- B. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

- F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

- G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 283111

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Removing existing vegetation.
2. Clearing and grubbing.
3. Stripping and stockpiling topsoil.
4. Removing above- and below-grade site improvements.
5. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Division 01 Section "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.
2. Division 01 Section "Execution" for field engineering and surveying.
3. Division 02 Section "Structure Demolition" for existing building demolition.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other 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. All stripped topsoil shall remain onsite and be distributed onsite per the Construction Manager's direction. See Earthwork specification for soil material instruction.

1.5 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- C. Utility Locator Service: Notify utility locator service and appropriate City and County agencies 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. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material shall be provided by the Geotechnical Engineer.
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site. Coordinate with Geotechnical engineer for acceptable soil material.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain.
- 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. Contractor to keep inspection logs of erosion control measures and update provided Storm Water Pollution Prevention Plan (SWPPP).

3.3 EXISTING UTILITIES

- A. Contractor to arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped, or removed if being replaced, that serve the existing building before proceeding with site clearing.
 - 2. Utility service shall be maintained to the adjacent school building during construction of the proposed building. Contractor shall coordinate with utility service providers to maintain service to the adjacent building as necessary. See demolition notes on drawings.
- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Do not proceed with utility interruptions without Construction Manager's and Owner's written permission.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
- 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 per geotechnical report requirements.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
 - 2. Geotechnical engineer to monitor stripping operations to observe that all unsuitable materials have been removed.

- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Do not stockpile topsoil within protection zones.
 - 2. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 3. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

- D. Remove all topsoil and all organic material from proposed building footprint and pavement areas. Excavate as deep as necessary to ensure all organic material has been removed.

3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated from the site. See demolition notes on drawings.

- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus unsuitable 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 non-recyclable 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 311000

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The geotechnical report referenced was prepared by Terracon Consultants, Inc., dated April 19, 2018, Terracon Project #02185070.

1.2 SUMMARY

- A. Section Includes:
 - 1. Excavating and backfilling trenches for utilities and pits for buried utility structures.
 - 2. Preparing subgrade for pavements and grass areas.
 - 3. General earthwork and excavation.
- B. Related Sections:
 - 1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.

1.3 UNCLASSIFIED SITE

- A. All site work for this project is considered "unclassified." The term "unclassified" excavation shall be defined as meaning the site contractor bears the entire risk of the soil quantities and/or types (e.g. rock, clay, peat, silt, shale, etc.) encountered above the bottom of required excavations and over-excavated / treated soils areas. Above the bottom of required excavations, the site contractor shall bear the entire cost of such additional work in the event it becomes necessary for unsuitable soils to be handled, removed from the site, or for suitable fill material to be imported to the site. This definition of "unclassified" supersedes any contrary definitions or statements which may be contained in the specifications, plans, or other contract documents. The unclassified site shall include all work above the bottom of required excavations and/or required soil remediation/replacement.
- B. The contractor shall be responsible to determine earthwork quantities and shall familiarize themselves with the geotechnical report. All import or export of earth material shall be the responsibility of the contractor at his expense.

1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- D. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- E. Fill: Soil materials used to raise existing grades.
- F. 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.
- G. 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.
- H. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Warning tapes.
- B. Qualification Data: For qualified testing agency.
- C. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill according to Geotechnical Engineer requirements.
- D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Pre-excavation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service and City and County agencies for area where Project is located before beginning earth moving operations.
- C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures 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: All material incorporated in engineered fill sections shall follow the recommendations found in the Geotechnical Engineering Report section titled, "Fill Material Types." Material listed as "Suitable" in the table provided in this section shall be acceptable for use as fill.
- C. Unsatisfactory Soils: All material incorporated in engineered fill sections shall follow the recommendations found in the Geotechnical Engineering Report section titled, "Fill Material Types." Material listed as "Marginally Suitable", or "Unsuitable" in the table provided in this section shall not be acceptable for use as fill.
- D. Sub-drainage Aggregate: Naturally or artificially graded mixture of natural stone, clean with no fines. Aggregate range shall be ½" to ¾".

2.2 GEOTEXTILES

- A. 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 3; AASHTO M 288.
 - 2. Grab Tensile Strength: 120 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 - 4. Tear Strength: 50 lbf; ASTM D 4533.
 - 5. Puncture Strength: 90 lbf; ASTM D 4833.
 - 6. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 1.7 second-1, minimum; ASTM D 4491.
 - 8. UV Stability: 70 percent after 500 hours' exposure; ASTM D 4355.
 - 9. Use Mirafi 140N or approved equal.

2.3 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems.
 - 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- D. Prepare low-volume-change subgrade material beneath proposed building per geotechnical report recommendations.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials as determined by the Geotechnical Engineer.
- B. The Geotechnical Report indicates existing fill materials consisting of lean clay and fat clay with varying amounts of gravel encountered in Borings B-1 and B-2 to depths of 1 ½ to 3 feet below existing ground surface elevations. Existing fill material encountered within the new building footprint and extending a minimum of 5 feet laterally outside proposed building wall lines shall be removed and replaced with engineered fill placed according to the recommended compaction requirements in the Geotechnical Report section entitled "Earthwork." The new building foundation shall bear on stiff native clay soils or newly placed engineered fill.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Evaluate surfaces under future walks and pavements to indicated lines, cross sections, elevations, and subgrades, and excavate unsuitable materials as recommended by the geotechnical engineer.

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: As indicated on plans.

3.7 PAVEMENT SUBGRADE INSPECTION

- A. Notify testing agency when excavations have reached required subgrade.
- B. If Geotech Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below proposed pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Proof-roll within two days of paving operations.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Geotechnical Engineer, and replace with compacted backfill or fill as directed to the proper moisture content and density.
 - 3. After proof rolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified to a depth of 8 inches and uniformly compacted to at least 95% of the standard proctor maximum dry density to provide a uniform subgrade for pavement construction. Moisture content and density of subgrade to be checked within two days prior to the commencement of paving operations.
 - 4. Soil treatment...
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, without additional compensation.
- E. Subgrades under pavements and building pads shall be free of all organic material.

3.8 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.

3.9 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.

5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

C. Backfill tree root ball excavations with structural fill per geotechnical report. Areas under pavements or building pads shall be compacted to 95% standard density. All other areas shall be compacted to 90% standard density.

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. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

D. Install a clay plug around pipes within 5' of the building face to prevent water migration through the trench into the building. Plug material should consist of clay compacted at a water content at or above the soils optimum water content.

E. Utility trenches should be backfilled per the requirements of the geotechnical report **and plan details**.

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 **9 inch** loose lifts and compacted to at least 95% of the materials max dry density and moisture control as recommended in the geotechnical report.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

D. The exposed grade prior to fill being placed shall be scarified to a minimum depth of 12" and the moisture content should be adjusted to within the range recommended for structural fill. The material should then be proof-rolled and compacted per the geotechnical report requirements.

E. Bench existing slopes of 5:1 or greater where fill is to be placed.

F. Fill placement and compaction requirements shall conform to the geotechnical report.

3.12 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction per the geotechnical report requirements.

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, soil material that is not in conformance with the guidelines of the geotechnical report.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 9 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 requirements determined by Geotechnical Engineer.
- D. Utility trenches – compaction testing to be performed every 200 cubic yards at backfill or each lift within 200 linear feet of trench, whichever is less.

3.14 BUILDING PAD PREPARATION

- A. Prepare low-volume change material, capillary barrier, and vapor barrier for the building pad per the geotechnical report and onsite geotechnical representative recommendations. Low volume change (LVC) material placed below the building floor slabs can consist of well graded crushed stone aggregate (e.g. MoDOT Type 5). Lean clay with a liquid limit less than 45 and a plasticity index less than 23 could also be used as LVC material, but be protected from becoming wetted by surface water and precipitation in order to prevent softening and disturbance. A 4 inch minimum granular leveling course consisting of well graded crushed stone, (e.g. MoDOT Type 5 aggregate) or open-graded crushed stone (e.g. ASTM C33, Size No. 57 aggregate). If the leveling course is used immediately below the floor slabs, this material can be considered part of the required 24 inch LVC zone depth.
- B. Moisture condition and compact native soils below the LVC zone as necessary per geotechnical report and onsite geotechnical representative.
- C. Proof-roll subgrade below proposed building pads with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Proof-roll within two days of building pad construction.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Geotechnical Engineer, and replace with compacted backfill or fill as directed to the proper moisture content and density.
 - 3. After proof rolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified and uniformly compacted to at least 95% of the standard proctor maximum dry density to provide a uniform subgrade for building pad construction. Moisture content and density of subgrade to be checked within two days prior to the commencement of building pad construction.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1/4 inch.
 - 3. Pavements: Plus or minus 1/4 inch.

3.16 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material and maximum lift thickness comply with requirements.
 - 3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.
- 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. 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.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Install erosion control measures as indicated on the plans. Install additional measures as necessary to prevent erosion or damage to erosion control measures.
- C. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- D. 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.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Transport surplus satisfactory soil offsite. Stockpile / spread topsoil per contract documents prior to soil removal from site.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil treatment with termiticide.
- B. Related Requirements:
 - 1. Section 061000 "Rough Carpentry" for wood preservative treatment by pressure process.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the EPA-Registered Label for termiticide products.
- B. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
 - 2. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product certificates.
- C. Soil Treatment Application Report: Include the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Termiticide brand name and manufacturer.
 - 4. Quantity of undiluted termiticide used.
 - 5. Dilutions, methods, volumes used, and rates of application.
 - 6. Areas of application.
 - 7. Water source for application.
- D. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.
- C. Source Limitations: Obtain termite control products from single source from single manufacturer.
- D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil to tops of footings and grade beams; and beneath ground-supported slabs before construction.

1.7 WARRANTY

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
 - 1. Warranty Period: Five (5) years from date of Substantial Completion.

1.8 MAINTENANCE SERVICE

- A. Continuing Service: Beginning at Substantial Completion, provide 12 months continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

- A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation, Agricultural Products; Termidor.
 - b. Bayer Environmental Science; Premise 75.
 - c. FMC Corporation, Agricultural Products Group; Dagnet FT.
 - d. Syngenta; Prelude.
 - 2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
 - 1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
 - 1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
 - a. Treat soil materials beneath floor slabs on grade extending treatment 5 feet beyond perimeter of building on all sides.
 - 2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
 - 3. Crawlspace: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
 - 4. Masonry: Treat voids.
 - 5. Penetrations: At expansion joints, control joints, and areas where slabs will be penetrated.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.5 PROTECTION

- A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.6 MAINTENANCE SERVICE

- A. Continuing Service: Beginning at Substantial Completion, provide 12 months continuing service including monitoring, inspection, and re-treatment for occurrences of termite activity. Provide a standard continuing service agreement. State services, obligations, conditions, terms for agreement period, and terms for future renewal options.

END OF SECTION 313116

SECTION 313200 - SOIL STABILIZATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Excavating and backfilling for buildings within building lines.
 - 2. Placing controlled, compacted structural (low volume change) fill for building slabs on grade.
- B. Related work in other sections:
 - 1. Section 033000 "Cast-in-Place Concrete" for granular capillary break/leveling course fill material beneath building slabs on grade.
 - 2. Section 311000 "Site Clearing."
 - 3. Section 312000 "Earth Moving."

1.2 DEFINITIONS

- A. Excavation consists of removal of material encountered to design subgrade elevations indicated, and below design subgrades, where yielding soils are encountered and subsequent disposal of materials removed.
- B. Subgrade: The undisturbed earth (subsoil) or the compacted soil layer immediately below granular drainage fill, or topsoil materials.
- C. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.
- D. Proofrolling: The utilization of earth moving equipment to identify unstable and unsuitable insitu subsoils and subgrade materials. Soil at or below subgrade level which are soft, unstable and generally unsuitable for intended use; as determined by Owner's Soils Engineer. Unsuitable areas shall be improved by compaction or by under cutting and placement of suitable engineered compacted fill. Proofrolling shall be accomplished with a fully loaded, tandem-axle dump truck loaded to 18,000 pounds per axle or other equipment providing an equivalent subgrade loading.
- E. Granular Drainage/Capillary Break Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water. Refer to Section 033000 for requirements.
- F. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.
- G. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- H. Design Subgrade Elevation: For the purpose of this Section, design subgrade elevations are defined as follows:
 - 1. For footings, foundation walls, grade beam foundations and retaining walls; design subgrade shall be the bottom of the footing, foundation wall, grade beam foundation and retaining wall as shown on the drawings cut into soil material.
 - 2. For slabs on grade; design subgrade elevation shall be the bottom of the compacted engineered structural (low volume change) fill material as set forth in the specifications.
 - 3. No additional cost shall be included when rock and below grade improvements are encountered within 28" below design subgrade elevation as defined for items 1 and 2 above.
 - 4. No additional cost shall be included when yielding unsuitable subgrades are encountered beneath design subgrade elevation as defined for items 1 and 2 above.

1.3 ACTION SUBMITTALS

- A. Materials Certificates: Provide materials certificates signed by manufacturer and Contractor, certifying that imported low plasticity soil and well graded granular materials meet or exceeds, specified requirements.
- B. Test Reports: Submit the following reports directly to Architect and Owner's Soils Engineer from the testing services, with copy to Contractor. Test reports shall be submitted not more than seven (7) calendar days prior to incorporation into the work.
 - 1. Contractor's Testing Responsibilities:
 - a. Test reports on off-site borrow material proposed.
 - 2. Owner's Testing Responsibilities:
 - a. Verification of suitability of each footing and building slab subgrade material, in accordance with specified requirements.
 - b. Verification of on-site soils used for engineering fill associated with low volume change layer.
 - c. Field reports; in-place soil density tests.
 - d. One optimum moisture-maximum density curve for each type of soil encountered.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Perform work of this Section in compliance with applicable requirements of Jackson County, Missouri, Technical Specifications, latest edition, and the following:
 - 1. 2012 International Building Code.
- B. Soils Investigations: Soils investigations and recommendations for foundations have been made by Terracon, of Lenexa, Kansas. The report and boring logs are included in this Project Manual for reference.
- C. Soils Testing:
 - 1. The Owner shall employ a licensed geotechnical engineer registered in the state where the projects are located to: test and approve all fill material within the building pad area; inspect and approve exposed building pad subgrade materials before placement of compacted structural (low volume change) fill material and granular drainage fill; inspect and approve soil at footing and grade beam bearing elevations; test and approve compacted fill during and after placement; and verify that the soils under floor slabs are at the specified moisture content immediately prior to placing concrete floor slabs.
 - 2. The Contractor shall employ a Testing Laboratory acceptable to the Architect to test all borrow material.
 - 3. Re-testing areas where original test failed will be at Contractor's expense.
- D. Testing Laboratory Qualifications: To qualify for acceptance, the GeoTechnical Testing Laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM D 3740 and ASTM E 329, that it has the experience and capability to conduct required field and laboratory GeoTechnical testing without delaying the progress of the Work.
- E. Staking: Refer to paragraph 3.1.D of this Section.

1.5 PROJECT CONDITIONS

- A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are included in these specifications for the Contractor's information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.
 - 1. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
 - 2. All earthwork and soil stabilization shall be performed in accordance with the specifications and in compliance with applicable requirements of governing authorities having jurisdiction. Where conflicts occur between requirements the more stringent requirement will govern.
 - 3. Building Pad Subgrades: It may be necessary for this Contractor to recondition the controlled, compacted structural fill (low volume change material) and bring it back to final design elevation.

- B. Existing Utilities: Contractor shall verify and confirm locations of existing underground utilities within the area of the building pad and pavements. If utilities are indicated to remain in place, provide adequate means of support and protection during soil stabilization operations.
 - 1. Should uncharted, or incorrectly charted utilities be encountered during soil stabilization operations, consult Utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Utility Owner.
 - 2. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.
 - a. Provide minimum of 72-hour notice to Architect, and receive written Notice to Proceed before interrupting any utility.

1.6 PROTECTION

- A. Traffic: Conduct work of this Section to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Clean roads and streets of debris caused by work under this Section daily.
- B. Warning Lights: Provide and operate warning lights as recommended by authorities having jurisdiction.
- C. Protecting Existing Improvements: Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by soil stabilization operations.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to Property Owners.
- D. Protecting Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General requirements for site clearing and earth moving is indicated on the Civil Drawings and in Sections 311000 Site Clearing and 312000 Earth Moving. Owner's Soils Engineer will approve all structural (engineered) fill used for the low volume change (transition layer) material beneath building slabs.
- B. Structural (Engineered) Fill for Low Volume Change (Transition Layer): All engineered structural fill materials must be approved by the Owner's Soils Engineer. Fill material shall be free of organic (organic contents less than 5%) and other deleterious material, and have a maximum particle size less than 3 inches. Low volume change material shall be; fly ash stabilized existing soil material, low plasticity cohesive soil or granular, as follows:
 - 1. USCS Classifications:
 - a. CL, On-site or imported inorganic low plasticity cohesive soil or granular soil having at least 18% low plasticity fines. Material shall have a Liquid Limit less than 45, (per wet preparation procedures of ASTM D 4318) and Plasticity Index (PI) less than 25.
 - b. GM, similar to MoDOT Type 5 well-graded crushed stone aggregate.
 - 2. Note: The 4 inch course of granular drainage fill (capillary break material) may be considered as part of the 24 inch thick transition layer material.
- C. Granular Capillary Break Fill: Refer to Section 033000.
- D. Backfill of Building Pad Areas: Use same material specified for the Structural (Engineered) fill for the Low Volume Change (Transition layer) material.

PART 3 - EXECUTION

3.1 PREPARATION

- A. The Contractor shall verify the location and depth of any existing utilities within the building pad areas at least 72 hours prior to construction. Prior to commencement of work, the Contractor shall notify all those companies which have facilities in the vicinity of the construction.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulation materials as necessary.
- C. The Contractor shall maintain the building pad site and conduct soil stabilization operations to ensure that the property is well drained at all times.
- D. The Contractor shall survey or Contractor shall engage a registered professional surveyor to survey and layout all stakes, batterboards, etc. in a timely manner prior to and during construction operations.
 - 1. Owner will have building corners staked for control points for Contractors to work from. Each Contractor is responsible for their own layout.

3.2 PROTECTION

- A. Locate, identify and protect utilities that are to remain from damage. Contractor shall make every reasonable effort to protect all existing utilities from damage. If any utility is damaged through the carelessness or negligent actions of the Contractor, the utility shall be repaired by its owner at the Contractor's expense.
- B. Any private facilities damaged or disturbed by the Contractor's work shall be repaired by the Contractor prior to close of the working day. Repairs shall be made in a manner sufficient to restore utility service to that property.
- C. Protect benchmarks from excavation equipment and vehicular traffic.
- D. The Contractor shall protect all property corners and control monuments from damage or displacement. Should it become necessary to disturb any corner or monument, the Contractor shall be responsible for referencing the markers prior to removal, resetting them and filing such relocation in accordance with state and local regulations. All such work involving property corners and control monument shall be performed by Contractor's registered, licensed land surveyor. A copy of all certification documents shall be submitted to the Engineer prior to completion of the project.
- E. Prevent surface water and subsurface or ground water from entering building pad excavations, from ponding on prepared subgrades, and from flooding building pad and pavement areas.

3.3 SITE CLEARING

- A. General: Removal of trees, shrubs, grass and other vegetation, improvements, and obstructions is specified under Section 311000.
- B. Topsoil: Topsoil removal is part of the work specified under Section 311000. Topsoil shall be removed and stored on-site at location as directed by the Owner.
- C. General earth moving operations and requirements is specified in Section 312000 "Earth Moving".

3.4 EXCAVATION

- A. Excavation is unclassified and includes excavation to design subgrade elevations indicated, in addition to yielding unsuitable soil below design subgrade elevations, regardless of character of materials and obstructions encountered.
 - 1. General excavation and site grading is specified on the Civil Drawings and under Sections 311000 and 312000: The area of the building pad extending 5'-0" beyond the building line will be prepared under Section 312000 and should be brought to within 0.10' of the bottom of the transition layer design subgrade elevation.
- B. Prior to placement of controlled, compacted Structural(Engineered) fill (low volume change transition layer) materials and in presence of Owner's Soil Engineer, evaluate subgrade moisture content, density

and proofroll exposed subsoil to identify and delineate unsuitable yielding subgrade areas and areas of undocumented fill.

1. Scarify and compact the first 12 inches of in-situ subgrade. Compact to 95 percent of materials standard Proctor maximum dry density
2. Unsuitable and unstable areas shall be improved by undercutting and placement of suitable compacted fill as specified in Section 312000.

3.5 STABILITY OF EXCAVATIONS

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace areas adjacent to existing foundations and where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.
 1. Owner's Soils Engineer will determine extent of permanent shoring required. Contractor shall place shoring and bracing adjacent to existing building where excavation is necessary to accommodate new construction.
 2. Provide permanent steel sheet piling or pressure-creosoted timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2'-6" below final grade and leave permanently in place.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect.

3.6 DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into building pad excavations.
 1. Do not allow water to accumulate in excavations and on prepared subgrades. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of building pad and pavement subgrades, and building foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 2. If prolonged ponding of surface water occurs, removal and replacement of wet or disturbed soils may be necessary as determined by Owner's Soils Engineer.

3.7 STORAGE OF EXCAVATED MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill where shown on drawings or as directed by Architect. Place grade, and shape stockpiles for proper drainage.
 1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
 2. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill.

3.8 EXCAVATION FOR STRUCTURES

- A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10' and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.
 1. Extend excavation for building pad 5'-0" beyond building lines, except where excavation occurs adjacent to existing buildings.
 2. Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
 3. Undercutting to facilitate placement of the low volume change (transition) layer is not necessary in areas where more than 2 feet (24 inches) of fill will be placed to develop the floor slab subgrade level. Note that this 2 foot requirement includes the 4 inch thick granular capillary break fill material layer.

3.9 COLD WEATHER PROTECTION

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.10 BACKFILL AND FILL

- A. General: Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in Part 2 of this Section.
 - a. Under building slabs: Use granular capillary break drainage fill material from bottom of slab-on-grade down 4", use controlled, engineered structural fill (low volume change transition layer) material from bottom of drainage fill down 20", to prepared subgrade. Total thickness for the low volume change (transition) layer shall not be less than 24" and the granular drainage fill (capillary break) material may be considered a part of the low volume change (transition) layer.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:
 - 1. Visual inspection by Owner's Soils Engineer of foundation bearing materials.
 - 2. Acceptance of construction below finish grade including where applicable, dampproofing, waterproofing, and perimeter insulation.
 - 3. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
 - 4. Removal of concrete formwork.
 - 5. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
 - 6. Removal of trash and debris from excavation.
 - 7. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.11 FILL PLACEMENT AND COMPACTION

- A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip or break up sloped surfaces steeper than 1 vertical to 5 horizontal so that fill material will bond with existing surface.
 - 1. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.
 - 2. All slopes steeper than 1 vertical to 3 horizontal in fill areas shall be benched prior to placement of fill. Benches shall be cut as fill placement progresses. Benching heights shall not exceed 3 feet.
 - 3. The crest, toe of cut or fill slopes shall be no closer than 10 feet from any foundation and no closer than 5 feet from the edge of any pavement.
- B. Place backfill and fill materials in layers not more than 8 inches in loose thickness for material compacted by heavy compaction equipment, and not more than 6" in loose thickness for material compacted by hand-operated tampers.
- C. Before compaction, moisten or aerate each layer as necessary to adjust soil water content to specified range as determined by Owner's Soils Engineer. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- D. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Owner's Soils Engineer if soil density tests indicate inadequate compaction.
- E. Percentage of Maximum Density Requirements: Compact soil to not less than 95 percent of material's maximum dry density, in accordance with ASTM D 698 (Standard Proctor Compaction), unless otherwise specified hereinafter.
 - 1. Granular (cohesionless) fill materials: Where percentage passing the U.S. Standard No. 200 sieve is less than 15 percent by dry weight and the moisture density curve indicates only slight sensitivity to changing moisture content, compact each layer of backfill and fill material to at least 70 percent Relative Density in accordance with ASTM D 4253. Note that relative density and standard Proctor compaction tests measure different parameters and are not interchangeable.
 - 2. Under building slabs: Compact each layer of backfill or fill material to at least 95 percent of the materials maximum dry density.

- F. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations. Mix by disking or other methods to achieve uniform water content throughout fill material.
 - 1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - 2. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by disking, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.
 - 3. Structural Lean Clay Fill (Cohesive): Moisture content at time of compaction shall be within a range of 1 percent below to 3 percent above optimum moisture content as defined by the Standard Proctor compaction procedures. Aeration or wetting may be required to achieve compaction.
 - 4. Structural Fat Clay Fill (Cohesive): Moisture content at time of compaction shall be within a range of 0 to 3 percent above optimum moisture content as defined by the Standard Proctor compaction procedures. Aeration or wetting may be required to achieve compaction.
 - 5. Structural Fill (Granular): Moisture content at time of compaction shall be within a range of 2 percent below to 2 percent above optimum moisture content as defined by the Standard Proctor compaction procedures.
- G. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

3.12 GRADING

- A. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.
- B. Grading Surface of Fill under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½" when tested with a 10' straightedge.
- C. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.13 FIELD QUALITY CONTROL

- A. Quality Control Testing during Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
 - 1. Perform field density tests using the nuclear method in accordance with ASTM D6938, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gauges in accordance with ASTM D6938.
 - a. Make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
 - 2. Footing Subgrade: For each strata of soil on which footings (or grade beams) will be placed, perform at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Owner's Soils Engineer.
 - 3. Building Slab Subgrade: Perform at least one field density test of subgrade for every 2,500 sq ft of building slab area, but in no case fewer than three tests per fill lift.
 - a. In each compacted fill layer, perform one field density test for every 2,000 sq ft of overlaying building slab or paved area, but in no case fewer than three tests.
 - 4. Foundation Backfill: Perform at least two field density tests at location and elevations as directed
 - 5. If in opinion of Owner's Soils Engineer, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

3.1 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded building pad areas from traffic and erosion. Keep free of trash and debris.

- B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape and compact to required density prior to further construction.
- D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact and replace surface treatment. Restore appearance quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.2 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Burning on Owner's Property will not be permitted.
- B. Removal from Owner's Property: Remove and transport waste materials and unsuitable/excess materials from Owner's property and legally dispose of off site.

END OF SECTION 313200

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.

B. Related Sections:

1. Section 312000 "Earth Moving" for aggregate subbase and base courses.
2. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: For each job mix proposed for the Work.

- B. Material Certificates: For each paving material, from manufacturer. Certifying that each material complies with or exceeds specified requirements.

- C. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with a history of successful performance.

- B. Installer Qualifications: Engage an experienced installer who is trained and approved for installations required for this Project.

- C. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

- D. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the pavement specifications called out in the geotechnical report for asphalt paving work.

- E. Pre-installation Conference: Conduct conference at a site acceptable to the Construction Manager.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

- a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
- b. Review condition of subgrade and preparatory work.
- c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
- d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Tack Coat: Minimum surface temperature of 50 deg F.
 - 2. Slurry Coat: Comply with weather limitations in ASTM D 3910.
 - 3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of 50 deg F at time of placement and when base is dry.

PART 2 - PRODUCTS

2.1 MATERIALS AND MIXES

- A. General: All work on the site as herein called for shall be done in accord with the American Public Works Association (APWA), Kansas City Metropolitan Chapter, Division II, "Construction and Materials Specifications for Paving", Section 2200, latest edition. The work herein required is not of the magnitude of work described in the aforesaid Standard Specification, therefore only applicable limitations will be enforced. However, this is not a relaxing of the requirements for the quality of the work. When work is obviously substandard, necessary tests will be made for compliance to the specifications. Work found to be in noncompliance with the specification shall be removed and replaced at the expense of the Contractor, including the costs of all tests.
 - 1. Use locally available materials and gradations that exhibit a satisfactory record of previous installations.
- B. Base Course Mix: Conform to requirements for mix designations APWA Type 1-01, per section 2205 of referenced APWA Specifications. Recycled content per APWA specifications allowed.
- C. Surface Course Mix: Conform to requirements for mix designation APWA Type 3-01, per Section 2205 of referenced APWA Specifications. Virgin surface course only. Recycled wear course will not be allowed.
- D. Marking Paint: Alkyd-resin type, ready-mixed complying with AASHTO M248, Type I.
 - 1. Colors: White.

2.2 ASPHALT-AGGREGATE MIXTURE

- A. Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and as recommended by local paving authorities to suit project conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below proposed pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than **15 tons** to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Proof-roll within two days of paving operations.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Geotechnical Engineer, and replace with compacted backfill or fill as directed to the proper moisture content and density.
 - 3. After proof rolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified to a depth of **12 inches** and uniformly compacted to at least 95% of the standard proctor maximum dry density to provide a uniform subgrade for pavement construction. Moisture content and density of subgrade to be checked within two days prior to the commencement of paving operations.
 - 4. **Soil treatment...**
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, without additional compensation.
- D. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at minimum temperature required by the mix design and outside temperature.
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 5 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.

- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.7 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus or minus 1/4 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch.
 - 2. Surface Course: 1/8 inch.
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM standards.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Curbs and gutters
2. Walks
3. Driveways
4. Pavement

B. Related Sections:

1. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

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, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

B. Other Action Submittals:

1. 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.

- C. Qualification Data: For qualified Installer of detectable warnings, ready-mix concrete manufacturer, and testing agency.

D. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

- E. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

F. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of brick paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

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.

D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

E. ACI Publications: Comply with ACI 301 unless otherwise indicated.

F. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

- a. Concrete mixture design.
- b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

- a. Contractor's superintendent.
- b. Independent testing agency responsible for concrete design mixtures.
- c. Ready-mix concrete manufacturer.
- d. Concrete paving subcontractor.
- e. Manufacturer's representative of stamped concrete paving system used for detectable warnings.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
- D. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
1. Portland Cement: ASTM C 150, gray or white portland cement Type I.
 - a. Fly Ash: ASTM C 618, Class C.
 2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag or Type IP, portland-pozzolan cement.
- B. Normal-Weight Aggregates: ASTM C 33, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. 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.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
 - b. BASF Construction Chemicals, LLC; Confilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; VaporAid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; D.O.T. Resin Cure, DSSCC Clear Resin Cure.
 - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - e. Edoco by Dayton Superior; DSSCC Clear Resin Cure, Resin Emulsion Cure V.O.C. (Type I).
 - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; AQUA KURE - CLEAR.
 - i. L&M Construction Chemicals, Inc.; L&M CURE R.
 - j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
 - k. Nox-Crete Products Group; Resin Cure E.
 - l. SpecChem, LLC; PaveCure Rez.
 - m. Symons by Dayton Superior; Resi-Chem Clear.
 - n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
 - o. TK Products, Division of Sierra Corporation.
 - p. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

C. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. ChemMasters; Exposee.
- b. Conspec by Dayton Superior; Delay S.
- c. Dayton Superior Corporation; Sure Etch (J-73).
- d. Edoco by Dayton Superior; True Etch Surface Retarder.
- e. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.
- f. Kaufman Products, Inc.; Expose.
- g. Meadows, W. R., Inc.; TOP-STOP.
- h. Metalcrete Industries; Surfard.
- i. Nox-Crete Products Group; CRETE-NOX TA.
- j. Scofield, L. M. Company; LITHOTEX Top Surface Retarder.
- k. Sika Corporation, Inc.; Rugasol-S.
- l. SpecChem, LLC; Spec Etch.
- m. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
- n. Unitex; TOP-ETCH Surface Retarder.
- o. Vexcon Chemicals Inc.; Certi-Vex Envioset.

D. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Anti-Hydro International, Inc.; A-H S-Q Hardener.
- b. BASF Construction Chemicals, LLC; Mastercron.
- c. ChemMasters; ConColor.
- d. Conspec by Dayton Superior; Conshake 600 Colortone.
- e. Dayton Superior Corporation; Quartz Tuff.
- f. Euclid Chemical Company (The), an RPM company; Surfex.
- g. Lambert Corporation; COLORHARD.
- h. L&M Construction Chemicals, Inc.; QUARTZPLATE FF.
- i. Metalcrete Industries; Floor Quartz.
- j. Scofield, L. M. Company; LITHOCHROME Color Hardener.
- k. Southern Color N.A., Inc.; Mosaics Color Hardener.
- l. Stampcrete International, Ltd.; Color Hardener.
- m. Symons by Dayton Superior; Hard Top.

2. Color: As indicated by manufacturer's designation.

2.6 WHEEL STOPS

A. Wheel Stops: Precast, air-entrained concrete, 3000-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4 inch in diameter, 10-inch minimum length.

2.7 CONCRETE CURBS

A. Curbs to comply with the plan details.

2.8 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. Use ASTM C150, Type 1 – portland cement. Aggregates per ASTM C33, Class 4.
1. See concrete requirements in geotechnical report.
 2. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 3. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
1. Compressive Strength (28 Days): 4000 psi.
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
 3. Slump Limit: 4 inches plus or minus 1 inch for paving and 2" plus or minus one inch for curbs and gutters.
- 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: 6 percent plus or minus 1 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 requirements as follows:
1. Fly Ash or Pozzolan: 25 percent.
 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M, and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Notify testing agency when excavations have reached required subgrade.
- B. Proof-roll subgrade below proposed pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than **15 tons** to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Proof-roll within two days of paving operations.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Geotechnical Engineer, and replace with compacted backfill or fill as directed to the proper moisture content and density.
 - 3. After proof rolling and repairing deep subgrade deficiencies, the entire subgrade should be scarified to a depth of **8 inches** and uniformly compacted to at least 95% of the standard proctor maximum dry density to provide a uniform subgrade for pavement construction. Moisture content and density of subgrade to be checked within two days prior to the commencement of paving operations.
 - 4. **Soil treatment...**
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, without additional compensation.
- D. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

- F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch (50-mm) overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

- 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

- 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent or epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

- 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

- 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

- a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

- 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

- a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

- 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

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 bleed-water 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.

3.8 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 moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

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-foot- long, unlevelled straightedge not to exceed 1/2 inch.
 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.

5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 CONCRETE CURBS

- A. Install curbs per plan details.

3.11 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements outlined in the geotechnical report.

3.13 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

THIS PAGE LEFT BLANK

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.

B. Related Sections:

1. Section 321216 "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
2. Section 321313 "Concrete Paving" for constructing joints in concrete pavement.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Pavement-Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafco Inc., an ERGON company; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
 - c. Pecora Corporation; 301 NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
 - b. Dow Corning Corporation; 890-SL.
 - c. Pecora Corporation; 300 SL.

C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Pecora Corporation; Urexpan NR-200.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafcoc Inc., an ERGON company; Superseal 444/777.
- B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Meadows, W. R., Inc.; Sealtight Hi-Spec or Sealtight 3405.
 - b. Right Pointe; D-3405 Hot Applied Sealant.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.
 - 3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place joint sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within cement concrete pavement:

1. Joint Location:
 - a. Expansion and isolation joints in cast-in-place concrete pavement.
 - b. Other joints as indicated.
2. Silicone Joint Sealant for Concrete: Single component, nonsag or single component, self-leveling.
3. Urethane Joint Sealant for Concrete: Multicomponent, pourable.
4. Hot-Applied Joint Sealant for Concrete: Single component.
5. Joint-Sealant Color: Grey.

B. Joint-Sealant Application: Joints between cement concrete and asphalt pavement.

1. Joint Location:
 - a. Joints between concrete and asphalt pavement.
2. Hot-Applied Joint Sealant for Concrete and Asphalt: Single component.
3. Retain subparagraph below if joint sealants specified are offered in a choice of colors and colors are not specified on Drawings. Typically, color choice is not available for pavement joint sealants.
4. Joint-Sealant Color: As indicated by manufacturer's designations.

END OF SECTION 321373

THIS PAGE LEFT BLANK.

SECTION 331100 – WATER UTILITY 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 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for a domestic service line and fire service line.

1.3 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including but not limited to, pipe, fittings, fire hydrant, valves, and bedding.
- B. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.5 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- G. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-pw" on piping.
2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, 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, including fire hydrants, 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 and fire hydrants 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.

1.7 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. Do not proceed with interruption of water-distribution service without Construction Manager's and Owner's written permission.

1.8 COORDINATION

- A. Coordinate the connection to the existing water mains with the Jackson County Public Water Supply District No. 2 (JCPWSD2) and Construction Manager, to minimize interruption of service.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. For 4" and 6" Service Lines – Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved and flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. For Water Service Lines Smaller than 4" – Soft Copper Tube: ASTM B 88, Type K (ASTM B88M, Type A), water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
2. Copper, Pressure-Seal Fittings:
 - 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) Viega: Plumbing & Heating Systems.
 - b. NPS 2 (DN 50) or Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - c. NPS 2 ½ to NPS 4 (DN 65 to DN 100): Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. 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.

2.2 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by:
 - a. Mueller Co.; Water Products Div.
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.

2.3 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
 - b. East Jordan Iron Works, Inc.
 - c. Flowserve.
 - d. McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
 - e. McWane, Inc.; Kennedy Valve Div.
 - f. McWane, Inc.; M & H Valve Company Div.
 - g. Mueller Co.; Water Products Div.
 - h. U.S. Pipe and Foundry Company.

2. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: City Specifications.
 - b. Tapping Sleeve: Stainless-steel, two-piece bolted sleeve with ductile iron 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: Mueller "open-right" gate valve.
3. 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.
4. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.4 BACKFLOW PREVENTERS

- A. Refer to Division 21, Wet Pipe Sprinkler Systems, for Backflow-Prevention Assembly specifications.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Earth Moving Section for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Bury piping with depth of cover over top at least 42 inches from top of pipe, unless otherwise noted.
- B. Install vertical bends as necessary on proposed water mains at utility crossings to maintain a minimum of two feet of vertical clearance between the water main and other utilities.
- C. 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.
- D. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping.
- E. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.3 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
 2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
 3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

3.4 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types to be used include the following:
 - 1. Bolted flanged joints.

3.5 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.

3.6 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support **NPS 2-1/2** and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.7 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

3.8 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water service lines at meter to be installed by utility
- C. Connect water-distribution piping to interior domestic water piping.

3.9 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test per City.
- C. Prepare reports of testing activities.

3.10 IDENTIFICATION

- A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.11 CLEANING

A. Disinfection: After installation, the entire main shall be flushed and disinfected by chlorination. Flushing shall be carried out until a turbidity-free water is obtained from all points along the main. The Contractor shall disinfect the main or prepare the main for disinfection by the owning authority when so noted in the Special Provisions.

1. Chlorination by the Contractor shall conform to AWWA C651 and be performed using a 1 percent chlorine solution prepared from granular calcium hypochlorite (1 pound (0.45 kg) of HTH per 8 gallons (30.31) of water). Water entering the new main shall receive a dose of the chlorine solution fed at a constant rate such that the water will have not less than 25 mg/l free chlorine.

Chlorine Required to Produce 25 mg/l
Concentration in 100 feet (30.5 m) of Pipe

<u>Pipe Diameter</u>		<u>1 Percent Chlorine Solution</u>	
<u>In.</u>	<u>mm.</u>	<u>Gal.</u>	<u>Litres</u>
4	100	0.16	0.61
6	150	0.36	1.36
8	200	0.65	2.46
10	250	1.02	3.86
12	300	1.44	5.45

1. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances.
2. At the end of the 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.
3. Mains shall be flushed prior to placing in service. The flushing water shall be disposed of without damage to public or private property.
4. The contractor shall repeat disinfection procedure should initial treatment fail to yield satisfactory results.

B. Hydrostatic Testing: The Contractor shall perform hydrostatic pressure and leakage tests in accordance with AWWA C600 procedures. Where practicable, mains shall be tested in lengths between line valves or plugs of no more than 1,500 feet (460 m) in length.

C. All testing shall follow City specifications.

D. Conduct test at a pressure of 150 psi (10.34 Bar) measured at the highest point of the main. Duration of the test shall be not less than 2 hours. Maintain pressure throughout test +5 psi (0.35 Bar) of test pressure.

E. Leakage test shall be conducted concurrently with the pressure test. Acceptable when leakage does not exceed that determined by the following formula:

English Units

- L = $0.0000075SD(P)^{1/2}$, in which
- L = maximum allowable leakage in gallons per hour
- S = length of pipe tested in feet
- D = nominal internal diameter of pipe being tested in inches
- P = average actual leakage test pressure in psi

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in (0.012 L/hr/mm) of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be made against the closed hydrant. All visible leaks at exposed joints and all leaks evident on the surface where joints are covered shall be repaired regardless of total leakage as shown by test. All pipe, fittings, valves and other materials found to be defective under test shall be removed and replaced at the Contractor's expense.

Lines which fail to meet test shall be repaired and retested as necessary until the test requirements are met.

3.12 WATER MAINS NEAR SANITARY SEWERS

- A. **Horizontal Separation:** Whenever possible, a water main shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer, or manhole. When local conditions prevent a lateral separation of 10 feet, a water main may be laid closer than 10 feet to a sanitary or storm sewer, provided that the water main is laid in a separate trench, or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 24 inches above the top of the sewer. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and sewer must be constructed of mechanical or slip-on ductile-iron pipe, or prestressed concrete cylinder pipe and should be pressure tested to assure water tightness before backfilling.
- B. **Vertical Separation:** Whenever water mains must cross sanitary sewers, house sewers, or storm drains, the water main shall be laid at such an elevation that the bottom of the water main is 24 inches above the top of the drain or sewer. A full length of water main pipe shall be centered over the sewer line to be crossed so that the joints will be equally distant from the sewer and as remote therefrom as possible. This vertical separation shall be maintained for the portion of the water main located within 10 feet, horizontally, or any sewer or drain it crosses.
- C. **Unusual Conditions:** Where conditions prevent the minimum vertical separation set forth above from being maintained, or when it is necessary for the water main to pass under a sewer or drain, the water main shall be laid with slip-on or mechanical joint ductile-iron pipe which must extend on each side of the crossing to a distance from the sewer of at least 10 feet. In making such a crossing, a full length of water main pipe must be centered over or under the sewer to be crossed, so that the joints will be equidistant from the sewer and as remote therefrom as possible. The sewer line must also be constructed of ductile-iron pipe with slip-on or mechanical joints until the normal distance from the sewer line to the water main is at least 10 feet. Where a water main must cross under a sewer, a vertical separation of 24 inches between the bottom of the sewer and the top of the water main shall be maintained, with adequate support, especially for the larger sized sewer lines to prevent them from settling on and breaking the water main. The sewer shall be constructed of ductile-iron pipe for a distance of 10 feet on either side of the crossing, or other suitable protection as approved by the Engineer shall be provided. Where these conditions cannot be met, the Engineer shall be consulted as to the precautions to be taken to protect the public water supply.
- D. **Sewer Manholes:** No water pipe shall pass through, or come in contact with, any part of a sewer or a sewer manhole.

END OF SECTION 331100

THIS PAGE LEFT BLANK.

SECTION 333100 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Cleanouts.
 - 3. Manholes.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Pipes and fittings.
 - 2. Cleanouts.
 - 3. Manholes.

- B. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Do not proceed with interruption of service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

- A. PVC Gravity Sewer Piping:

1. Pipe: ASTM D 3034, SDR 26, PVC sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

2.2 CLEANOUTS

A. PVC 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. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.3 MANHOLES

- A. Manholes shall be per detail on construction documents and comply with City standards.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in the Earth Moving Section.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details 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. Install gravity-flow, nonpressure, drainage piping according to the following:
1. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
- E. 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 sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use PVC pipe fittings in sewer pipes at branches for cleanouts, and use PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 - 2. Use Heavy-Duty, top-loading classification cleanouts in the parking lot area.
- B. Set cleanout frames and covers in pavement areas in a cast-in-place-concrete block, 18 by 18 by 12 inches deep with 12 inches of treated 95% compacted subgrade below concrete. Set with top flush with surrounding pavement.

3.5 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."
- B. Make connections to existing / proposed piping and underground manholes and sewer mains.
 - 1. Connect to existing / proposed City sanitary sewer manholes and sewer mains. Coordinate with the City prior to installing sewer service on the school site and sewer mains and manholes in the public right-of-way.

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 report for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. 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 State Minimum Standards of Design.
 - 3. Perform low pressure air testing per the latest version of ASTM C828-76T per State Minimum Standards of Design.
 - 4. Test pipe for pipe deflection per State Minimum Standards of Design. The pipe deflection shall not exceed 5% of the inside diameter of the pipe.
 - 5. Schedule tests and inspections by City with at least 24 hours' advance notice.

6. Submit separate report for each test.

3.7 CLEANING

- A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

3.8 WATER MAINS NEAR SANITARY SEWERS

- A. Horizontal Separation: Whenever possible, a water main shall be laid at least 10 feet horizontally from any sanitary sewer, storm sewer, or manhole. When local conditions prevent a lateral separation of 10 feet, a water main may be laid closer than 10 feet to a sanitary or storm sewer, provided that the water main is laid in a separate trench, or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 24 inches above the top of the sewer. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both the water main and sewer must be constructed of mechanical or slip-on ductile-iron pipe, or prestressed concrete cylinder pipe and should be pressure tested to assure water tightness before backfilling.
- B. Vertical Separation: Whenever water mains must cross sanitary sewers, house sewers, or storm drains, the water main shall be laid at such an elevation that the bottom of the water main is 24 inches above the top of the drain or sewer. A full length of water main pipe shall be centered over the sewer line to be crossed so that the joints will be equally distant from the sewer and as remote therefrom as possible. This vertical separation shall be maintained for the portion of the water main located within 10 feet, horizontally, or any sewer or drain it crosses.
- C. Unusual Conditions: Where conditions prevent the minimum vertical separation set forth above from being maintained, or when it is necessary for the water main to pass under a sewer or drain, the water main shall be laid with slip-on or mechanical joint ductile-iron pipe which must extend on each side of the crossing to a distance from the sewer of at least 10 feet. In making such a crossing, a full length of water main pipe must be centered over or under the sewer to be crossed, so that the joints will be equidistant from the sewer and as remote therefrom as possible. The sewer line must also be constructed of ductile-iron pipe with slip-on or mechanical joints until the normal distance from the sewer line to the water main is at least 10 feet. Where a water main must cross under a sewer, a vertical separation of 24 inches between the bottom of the sewer and the top of the water main shall be maintained, with adequate support, especially for the larger sized sewer lines to prevent them from settling on and breaking the water main. The sewer shall be constructed of ductile-iron pipe for a distance of 10 feet on either side of the crossing, or other suitable protection as approved by the Engineer shall be provided. Where these conditions cannot be met, the Engineer shall be consulted as to the precautions to be taken to protect the public water supply.
- D. Sewer Manholes: No water pipe shall pass through, or come in contact with, any part of a sewer or a sewer manhole.

END OF SECTION 333100

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Pipe and fittings.
2. Cleanouts.
3. Drain Basins
4. End sections / pipe outfalls
5. Manholes / Junction Boxes.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 1. Drain Basin: Include elevations, details, covers, and depths.
 2. Concrete Structures: Include elevations, sections, details, frames, covers, and depths.
 3. End Sections: Product specifications and grate protection.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle stormwater inlets according to manufacturer's written rigging instructions.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of service.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

- A. HDPE N-12 Dual-Wall Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
 - 1. Soiltight Couplings: AASHTO M 252M, corrugated, matching tube and fittings.
 - 2. Use ADS N-12 HDPE pipe.
- B. HDPE N-12 Dual-Wall Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
 - 1. Soiltight Couplings: AASHTO M 294M, corrugated, matching pipe and fittings.
 - 2. Use ADS N-12 HDPE pipe.

2.2 PVC PIPE AND FITTINGS

- A. Pipe: ASTM D1785 Schedule 40 PVC, with plain ends for solvent-cemented joints.
- B. PVC pipe to be used as riser pipe for building downspouts below grade.

2.3 CONCRETE PIPE AND FITTINGS

- A. Reinforced-Concrete Sewer Pipe and Fittings conforming to ASTM C76.
 - 1. Bell-and-spigot ends with gasketed joints. O-ring gaskets shall be synthetic rubber and shall conform to ASTM C361 and ASTM C443.
 - 2. Class III, Wall B.

2.4 CLEANOUTS

- A. Plastic 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. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
 - 2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 DRAIN BASINS

- A. Drain basins shall be Nyloplast and shall meet all manufacturer specifications. See plans for size and depth.

2.6 STORMWATER INLETS / MANHOLES / JUNCTION BOXES

- A. Curb inlets, manholes, and junction boxes per plan details.

2.7 PIPE OUTLETS

- A. Install concrete toe wall on pipe end section and turf reinforcement mat at pipe end sections. See plans for location and details.
- B. Pipe outfalls shall have HDPE or CMP pre-manufactured end sections.
- C. HDPE end sections shall be manufactured by ADS, Inc. or approved equal. End sections shall have a toe plate to cast into a concrete toe wall.
- D. Corrugated metal end sections shall be fabricated from galvanized base metal, conform to ASTM A 760/A, and meet CMP pipe manufacturer design standards. End sections shall have a toe plate to cast into a concrete toe wall.

2.8 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 - 1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 - 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

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 according to manufacturer's written instructions for use of 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.
 - 2. Install PE corrugated sewer piping according to ASTM D 2321.
 - 3. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 4. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
 - 2. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
 - 3. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
 - 4. 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 Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 DRAIN BASINS

- A. Drain basins shall be installed per manufacturer specifications.

3.6 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Storm Drainage Piping."
- B. Make connections to piping.
 - 1. Use commercially manufactured wye fittings for piping branch connections unless a structure is indicated.
 - 2. Make connections to structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 - 3. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use warning tape or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.8 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 according to requirements of authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate report for each test.
 - 5. Gravity-Flow Storm Drainage Piping: Test according to 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 according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100

