

PROJECT MANUAL / SPECIFICATIONS

Document Issue Date: September 12th, 2017

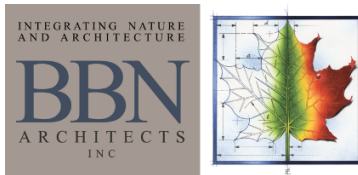
USD 320 Wamego-Phase 2, Bid Package 2- Multi-Purpose Building

Location of Project: Wamego High School, 801 Lincoln Ave.,
Wamego, KS, 66547

Owner: USD 320 Wamego, 1008 8th St., Wamego, KS 66547

Architect: BBN Architects Inc., 228 Poyntz Avenue, Manhattan, KS 66502

CMAR: Coonrod & Associates Construction Co., Inc., 3550 S. Hoover Rd., Wichita, KS,
67215



**USD 320 Wamego- Phase 2, Bid
Package 2- Multi-Purpose Building**

INSTRUCTIONS TO BIDDERS

Date: 10/3/2017

Construction Manager:	Brad Rice, Project Manager Scot Woffington, Project Lead	Coonrod & Associates Coonrod & Associates	bradr@coonrod.com	P: 316-942-8430
Architect:	Jack Austin, Steve Austin- Superintendents Dan Crouch Carl Riblett	Coonrod & Associates BBN Architects Inc. BBN Architects Inc.		

<u>USD 320 Wamego- Phase 2, Bid Package 2- Multi-Purpose Building</u>	<u>Bid Date</u>	<u>Time</u>
	<u>10/3/2017</u>	<u>2:00:00 PM, CST</u>

Bidding Procedures Public bid opening

Bids can be turned in at: **USD 320 District Office, 1008 8th St., Wamego, KS,
66547 at the PLC Room**

Faxed Bids are acceptable. Please send to the fax number **785-456-1690**

Emailed bids are acceptable. Please email to **bids@coonrod.com**

**FAXED OR EMAILED BIDS MUST RECEIVE VERBAL OR EMAIL ACKNOWLEDGEMENT OF RECEIPT - CALL 785-
556-4304.**

The owner, architect and construction manager will review the bids and determine the lowest, responsible bidder. The owner, architect and/or the construction manager reserve the right to reject any and/or all bids.

Late bids will not be considered.

Please use bid form provided.

There will be a bid scope sheet issued via addendum. Please review and bid accordingly.

Plans

www.gradebeam.com

Coonrod & Associates Main Office (3350 S. Hoover Rd., Wichita)

- Available for viewing in office only

<http://www.coonrod.com/wamego/>

Kansas Construction News Report- Wichita, KS

****Addenda only sent to bidders receiving plans from Gradebeam**

Bonding

Successful subcontract bidders over \$100,000 require Perf. & Payment Bonds

Include the price of the bid bond and P&P bond in the bid

Sales Tax

Exempt

Alternates:

None- Unless added by Addendum.

Unit Prices:

See specification section 012200 for Unit Prices 1, 2 and 3.

Schedule

Schedule will be issued via addendum.

Liquidated damages = \$500 / calendar day past substantial completion.

SUBSTANTIAL COMPLETION IS May 1st, 2018

Testing & Special Inspections

Per specific specification section requirements.

Submittals

Via Submittal Exchange

Misc. Items

1. ALL questions/RFI's pre-bid and during construction must be sent in writing. Please send to bradr@coonrod.com.

2. All subs/suppliers are responsible for having material delivered on time and have crews ready to go per the CM's schedule. There will be no added compensation for overtime work only unless there are circumstances out of the subcontractor's/supplier's control.

Each subcontractor is required to provide enough manpower to meet the schedule and your bid should reflect this accordingly.

Each subcontractor / supplier is to make sure that materials can and will arrive on time per the schedule BEFORE BIDDING. There will be no added compensation after the bid for accelerating the delivery time.

TABLE OF CONTENTS

Section	Title	Original Issue Date	Latest Issue Date
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PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

(By Construction Manager except as indicated)

00 26 00	Procurement Substitution Procedures	03/08/17	
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SPECIFICATIONS GROUP

GENERAL REQUIREMENTS SUBGROUP

DIVISION 01 – GENERAL REQUIREMENTS

01 11 00	Summary	03/19/17	
01 22 00	Unit Prices.....	03/11/17	
01 23 00	Alternates	04/06/17	04/13/17
01 25 00	Substitution Procedures	03/11/17	
	Request for Substitution Form		
01 29 00	Payment Procedures.....	03/11/17	
01 31 00	Project Management and Coordination	03/19/17	
01 32 00	Construction Progress Documentation	03/08/17	
01 33 00	Submittal Procedures	03/11/17	
01 40 00	Quality Requirements	03/19/17	
01 42 00	References.....	03/08/17	
01 50 00	Temporary Facilities and Controls.....	03/19/17	
01 60 00	Product Requirements.....	03/08/17	
01 73 00	Execution	03/19/17	
01 74 19	Construction Waste Management and Disposal	03/19/17	
01 77 00	Closeout Procedures	03/08/17	
01 78 23	Operation and Maintenance Data.....	03/08/17	
01 78 39	Project Record Documents	03/08/17	
01 79 00	Demonstration and Training	03/03/17	

FACILITY CONSTRUCTION SUBGROUP

DIVISION 02 – EXISTING CONDITIONS

02 41 19	Selective Demolition.....	03/03/17	
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DIVISION 03 – CONCRETE

03 30 00	Cast-in-Place Concrete	07/07/17	
03 33 00	Architectural Concrete.....	07/07/17	

~~**DIVISION 04 – MASONRY**~~

04 20 00	Unit Masonry	07/07/17	07/26/17
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DIVISION 05 – METALS

05 12 00	Structural Steel Framing	07/07/17	
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TABLE OF CONTENTS

Section	Title	Original Issue Date	Latest Issue Date
05 21 00	Steel Joist Framing.....	07/07/17	
05 31 00	Steel Decking.....	07/07/17	
05 40 00	Cold-Formed Metal Framing.....	07/07/17	
05 50 00	Metal Fabrications.....	07/07/17	
05 52 13	Pipe and Tube Railings.....	07/07/17	
05 58 00	Formed Metal Fabrications.....	07/07/17	
DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES			
06 10 00	Rough Carpentry.....	07/07/17	
06 17 53	Shop Fabricated Wood Trusses.....	07/07/17	
06 41 16	Plastic-Laminate-Faced Architectural Cabinets.....	07/07/17	
DIVISION 07 – THERMAL AND MOISTURE PROTECTION			
07 01 50	Preparation for Re-Roofing.....	03/31/17	04/13/17
07 13 26	Self-Adhering Sheet Waterproofing.....	07/24/17	
07 19 00	Water Repellents.....		
07 21 00	Thermal Insulation.....	07/07/17	
07 24 19	Water-Drainage Exterior Insulation and Finish System (EIFS)	07/07/17	
07 31 13	Asphalt Shingles.....	07/07/17	07/24/17
07 41 16	Standing Seam Metal Roof Panels.....	03/31/17	04/13/17
07 42 19	Insulated Metal Wall Panels.....	08/31/17	
07 42 93	Soffit Panels.....	07/07/17	
07 52 13	APP Modified Bituminous Membrane Roofing.....	07/12/17	07/24/17
07 71 00	Roof Specialties.....	07/07/17	07/24/17
07 72 00	Roof Accessories.....	07/07/17	
07 72 53	Snow Guards.....	03/31/17	
07 92 00	Joint Sealants.....	07/07/17	
DIVISION 08 – OPENINGS			
08 11 13	Hollow Metal Doors and Frames.....	07/07/17	
08 31 13	Access Doors and Frames.....	07/26/17	
08 33 13	Coiling Counter Doors.....	07/07/17	
08 33 23	Overhead Coiling Doors.....	07/07/17	
08 36 13	Sectional Doors.....	08/31/17	
08 41 13	Aluminum-Framed Entrances and Storefronts.....	07/07/17	
08 71 00	Door Hardware - Sports Complex.....	07/07/17	
08 71 10	Door Hardware - Central Kitchen.....	07/07/17	
08 71 20	Door Hardware - Multipurpose Building.....	08/31/17	
08 80 00	Glazing.....	07/07/17	
08 83 00	Mirrors.....	08/31/17	
DIVISION 09 – FINISHES			
09 21 16	Gypsum Board Assemblies.....	07/07/17	
09 51 13	Acoustical Panel Ceilings.....	07/07/17	07/08/17
09 61 13	Floor Sealers.....	07/26/17	
09 65 13	Resilient Base and Accessories.....	03/19/17	

TABLE OF CONTENTS

Section	Title	Original Issue Date	Latest Issue Date
09 65 19	Resilient Tile Flooring	03/19/17	
09 65 66	Resilient Athletic Flooring.....	08/31/17	
09 67 23	Resinous Flooring	07/07/17	07/24/17
09 68 13	Tile Carpeting	03/19/17	
09 68 23	Synthetic Turf Carpeting	08/31/17	
09 84 33	Sound-Absorbing Wall Units.....	03/31/17	
09 91 13	Exterior Painting	07/07/17	
09 91 23	Interior Painting	04/05/17	

DIVISION 10 – SPECIALTIES

10 11 16	Glass Markerboards	07/24/17	
10 14 19	Dimensional Letter Signage.....	07/07/17	
10 21 19	Toilet Compartments	03/19/17	
10 28 00	Toilet and Bath Accessories.....	07/07/17	
10 41 16	Emergency Key Cabinets.....	07/07/17	
10 44 00	Fire Protection Specialties	03/19/17	
10 44 16	Fire Extinguishers	07/26/17	
10 51 13	Metal Lockers	02/22/17	
10 51 15	Metal Athletic Lockers	07/07/17	07/28/17

DIVISION 11 – EQUIPMENT

11 13 16	Loading Dock Seals and Shelters	07/07/17	
11 13 19	Stationary Loading Dock Equipment.....	07/07/17	
11 23 00	Commercial Laundry Equipment.....		
11 40 00	Food Service Equipment.....	07/07/17	
11 52 13	Projection Screens.....	07/24/17	
11 66 23	Gymnasium Equipment		
11 66 90	Wall Pads	08/31/17	

DIVISION 12 – FURNISHINGS

12 35 53	Metal Laboratory Casework		
12 36 16	Solid Surfacing Countertops	03/31/17	
12 36 23	Plastic-Laminate-Clad Countertops	07/07/17	
12 66 00	Telescoping Stands		
12 93 00	Site Furnishings		

DIVISION 13 - SPECIAL CONSTRUCTION

13 34 16	Permanent Grandstands		
13 34 19	Metal Building Systems.....	08/31/17	
13 34 26	Prefabricated Pressbox.....		

TABLE OF CONTENTS

Section	Title	Original Issue Date	Latest Issue Date
FACILITY SERVICES SUBGROUP - CENTRAL KITCHEN AND SPORTS COMPLEX			
DIVISION 22 - PLUMBING			
22 00 00	Plumbing Systems.....	07/07/17	
DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING			
23 01 00	Basic Mechanical Requirements.....	07/07/17	
23 25 00	Insulation (Mechanical)	07/07/17	
23 60 00	Heating Equipment	07/07/17	
23 65 10	Rooftop Heating/Cooling Units	07/07/17	
23 65 75	Rooftop Heating Only Outside Air Supply Units	07/07/17	
23 80 00	HVAC Equipment - Air Side.....	07/07/17	
23 85 00	Ductwork and Accessories.....	07/07/17	
23 99 00	Testing, Adjusting, and Balancing (HVAC).....	07/07/17	
DIVISION 26 - ELECTRICAL			
26 01 00	Basic Electrical Requirements	07/07/17	
26 01 05	Ice and Snow Melting for Pavement.....	07/07/17	
26 16 00	Power Distribution Equipment	07/07/17	
26 17 00	Motor and Circuit Disconnects	07/07/17	
26 41 30	Standby Generator Systems - Natural Gas Engine	07/07/17	
26 41 60	Automatic Transfer Switches.....	07/07/17	
26 50 00	Lighting.....	07/07/17	
26 51 00	Site Lighting	07/07/17	
DIVISION 28 - ELECTRONIC SAFETY AND SECURITY			
28 72 10	Fire-Alarm Systems	07/07/17	
FACILITY SERVICES SUBGROUP - MULTIPURPOSE BUILDING			
DIVISION 22 - PLUMBING			
22 00 00	Plumbing Systems.....	09/01/17	
DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING			
23 01 00	Basic Mechanical Requirements.....	09/01/17	
23 25 00	Insulation (Mechanical)	09/01/17	
23 65 10	Rooftop Heating/Cooling Units	09/01/17	
23 80 00	HVAC Equipment - Air Side.....	09/01/17	
23 85 00	Ductwork and Accessories.....	09/01/17	
23 99 00	Testing, Adjusting, and Balancing (HVAC).....	09/01/17	
DIVISION 25 - INTEGRATED AUTOMATION			
25 90 00	Temperature Control.....	09/01/17	

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Original Issue Date</u>	<u>Latest Issue Date</u>
DIVISION 26 - ELECTRICAL			
26 01 00	Basic Electrical Requirements	09/01/17	
26 16 00	Power Distribution Equipment	09/01/17	
26 17 00	Motor and Circuit Disconnects	09/01/17	
26 50 00	Lighting.....	09/01/17	
DIVISION 27 - COMMUNICATIONS			
27 88 00	Intercom Systems.....	09/01/17	
DIVISION 28 - ELECTRONIC SAFETY AND SECURITY			
28 72 10	Fire-Alarm Systems	09/01/17	
 <i>SITE AND INFRASTRUCTURE SUBGROUP</i>			
DIVISION 31 – EARTHWORK			
31 20 00	Earth Moving	07/07/17	
31 31 16	Termite Control.....	07/07/18	
DIVISION 32 – EXTERIOR IMPROVEMENTS			
32 13 13	Concrete Paving.....		
32 13 73	Concrete Paving Joint Sealants.....		
32 31 19	Decorative Metal Fences and Gates.....		
32 84 00	Planting Irrigation		
32 91 19	Landscape Grading		
32 92 00	Turf Grass		
32 93 00	Plants.....		

END OF TABLE OF CONTENTS

SECTION 00 26 00 - PROCUREMENT SUBSTITUTION PROCEDURES**1.1 DEFINITIONS**

- A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.
- B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 01 25 00 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

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

1.3 PROCUREMENT SUBSTITUTIONS

- A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.
- B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:
 - 1. Extensive revisions to the Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
 - 3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

- A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing by prime contract Bidder only in compliance with the following requirements:
 - 1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
 - 2. Submittal Format: Submit three copies of each written Procurement Substitution Request, using form bound in Project Manual after Section 01 25 00 "Substitution Procedures."

- a. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specifications Sections and drawing numbers.
- b. Provide complete documentation on both the product specified and the proposed substitute, including the following information as appropriate:
 - 1) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures.
 - 2) Copies of current, independent third-party test data of salient product or system characteristics.
 - 3) Samples where applicable or when requested by Architect.
 - 4) Detailed comparison of significant qualities of the proposed substitute with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - 5) Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 6) Research reports evidencing compliance with building code in effect for Project, from ICC-ES or from code organization acceptable to Owner.
 - 7) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, which will become necessary to accommodate the proposed substitute.
- c. Provide certification by manufacturer that the substitute proposed is equal to or superior to that required by the Procurement and Contracting Documents, and that its in-place performance will be equal to or superior to the product or equipment specified in the application indicated.
- d. Bidder, in submitting the Procurement Substitution Request, waives the right to additional payment or an extension of Contract Time because of the failure of the substitute to perform as represented in the Procurement Substitution Request.

B. Architect's Action:

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

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

END OF SECTON 00 26 00

SECTION 01 10 00 - SUMMARY**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Project information.
 2. Work covered by Contract Documents.
 3. Access to site.
 4. Coordination with occupants.
 5. Work restrictions.
 6. Specification and drawing conventions.
- B. Related Requirements:
1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: USD 320 Wamego School District Improvements.
1. Project Locations:
 - a. Central Elementary School, 900 7th Street, Wamego, KS 66547
 - b. West Elementary School, 1911 Sixth Street, Wamego, KS 66547
 - c. Wamego Middle School, 1701 Kaw Valley Road, Wamego, KS 66547
 - d. Wamego High School, 801 Lincoln, Wamego, KS 66547
 - e. Wamego Sports Complex-Highway 24 and Columbian Rd.
 - f. Wamego Facilities and Bus Operations, 4290 Columbian Rd.
 - g. District Office
- B. Owner: USD 320 Wamego School District, 1008 8th Street, Wamego, KS 66547.
1. Representative: Tim Winter, Superintendent.
- C. Architect: BBN Architects Inc., 228 Poyntz Avenue, Manhattan, KS 66502.
1. Representative: Dan Crouch; dlc@bbnarchitects.com

- D. Construction Manager at Risk: Coonrod and Associates Construction Company, Inc., 3550 S Hoover Rd, Wichita, KS 67215.
1. Representative: Brad Rice.
 2. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
1. Renovation of existing facilities and construction of construction of new facilities.
- B. Type of Contract: Project will be constructed under a single contract with the Construction Manager at Risk.

1.5 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 areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Driveways, Walkways and Entrances: Keep driveways, parking areas, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.

2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.7 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 5:00 p.m., Monday through Friday, unless otherwise indicated.
 1. Weekend Hours: 7:00 a.m. to 5:00 p.m., with Owner's written permission.
- 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 Owner not less than two days in advance of proposed utility interruptions indicating specific times of the 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 Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Restricted Substances: Use of tobacco products and other controlled substances within the existing building or on Project site is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 22 00 - UNIT PRICES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 01 26 00 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 01 40 00 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION****3.1 SCHEDULE OF UNIT PRICES**

- A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, according to Section 31 20 00 "Earth Moving."
 2. Unit of Measurement: **Cubic yard (Cubic meter)** of soil excavated, based on in-place surveys of volume before and after removal.
 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 "Allowances."
- B. Unit Price No. 2: Rock excavation and replacement with satisfactory soil material.
1. Description: Classified rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, according to Section 31 20 00 "Earth Moving."
 2. Unit of Measurement: **Cubic yard (Cubic meter)** of rock excavated, based on survey of in-place surveys volume of before and after removal.
 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 "Allowances."
- C. Unit Price No. 3: Cutting and patching of concrete slabs-on-grade.
1. Description: Cutting of new or existing concrete slabs-on-grade up to [**6 inches (152 mm)**] **<Insert dimension>** thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete according to Section 01 73 00 "Execution." not otherwise indicated in the Contract Documents.
 2. Unit of Measurement: **Square feet (Square meters)** of concrete removed.

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other work of the Contract.
- C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Provide new locker installations.

Phase 1, BP
1- WMS
Locker
Replacement

1. Base Bid: Furnish and install new lockers to replace existing lockers as indicated on Drawings A101 through A106 and as specified in Section 10 51 13 "Metal Lockers."
2. Alternate: Furnish and install "Added" lockers in new locations as indicated on Drawing A103, Floor Plan Area C-1 and as specified in Section 10 51 13 "Metal Lockers."

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Request for Substitution Form (RFS): Use facsimile of form following this Section.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section.

Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from 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 Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS**2.1 SUBSTITUTIONS**

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

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Request for Substitution (RFS)

USD 320 Wamego School District Improvements Project Name

RFS No: _____
Date Issued: _____

Project Name: USD 320 Wamego School
District Improvement **Issued by:** _____
BBN Project No: _____ **Copies:** _____

Product, Material or Equipment Required of the Contract Documents:

Specification Section: _____ Drawing No./Detail: _____
Description: _____

Requested Substitute Product, Material or Equipment:

Description: _____
Manufacturer: _____ Trade Name: _____
Model Number: _____ Installer: _____

Attachments Included: Drawings Product Data Samples
 Test Reports Comparative Data

Reason for Substitution: _____

Has this item been used in a similar application? Yes No

Description: _____
Date Installed: _____
Owner Contact: _____

Comparisons of the Specified Item and the Proposed Substitution:

Compliance with specified quality, size, weight, durability, performance and visual appearance:
Describe any changes required in other elements of the Work:
Describe any changes of the Work required by the Owner, separate Contractors, or Consultants:
Verify all specified warranties, code and accessibility compliance, sustainability, and other requirements are met:
What affect with and without approval of the proposed substitution will there be on the Work Schedule:

Project Name: USD 320 Wamego School District
Improvements

RFS No: _____

Provide detailed breakdown of the cost comparison of the required item to the proposed substitution, including modifications required to other Work:

Proposed Substitution Summary:

Net Cost to the Owner:

Change in Contract Time:

Signatures:

Permission to make any substitution after Award of Contract shall be effected by Change Order (CO). CO shall not relieve the Contractor, any subcontractor, or manufacturer, fabricator, or supplier from the responsibility for any deficiency that may exist in the substituted product or any departures or deviations from the Contract Documents as modified by such CO. Except as otherwise expressly specified by the Contractor in the Request for Substitution (RFS) and expressly approved in such CO, the Contractor shall be deemed to warrant, by his request, that the proposed substitute will satisfy all standards and requirements satisfied by the original product, material or equipment specified and the CO shall not be deemed to modify the Contract Documents with respect thereto. If any substitution will affect a correlated function, adjacent construction, or the work of other trades or contractors, the necessary changes and modifications to the affected work shall be considered as an essential part of the proposed substitution, to be accomplished by the Contractor without additional expense to the Owner if and when accepted. The Contractor shall be deemed to warrant the Net Cost to the Owner and Change in Contract Time stated in this RFS are complete, and claims for additional Cost or Time related to the substitution which may become subsequently apparent are waived.

Contractor's Signature: _____ **Date:** _____

Response:

- | | |
|-------------|--|
| RFS Action: | <input type="checkbox"/> Approved |
| | <input type="checkbox"/> Make Corrections Noted |
| | <input type="checkbox"/> Revise as Noted and Resubmit |
| | <input type="checkbox"/> Rejected, Resubmit Specified Item |
| | <input type="checkbox"/> Action Not Taken |
| | <input type="checkbox"/> More Information Required |

RFS Response by: _____ **Date:** _____

BBN Architects, Inc.

BBN Architects, Inc. **Contractor:** _____ **Owner:** _____

Accepted By: _____ **Accepted By:** _____ **Accepted By:** _____

Date: _____ **Date:** _____ **Date:** _____

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 22 00 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 2. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedules.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one-line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. 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 percent of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
 7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

8. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
11. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager 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 the last day of each month or as otherwise indicated in the Contract Agreement. The period covered by each Application for Payment starts on the day following the end of the preceding period and ends 15 days prior to the date for each progress payment.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Sustainable design submittal for project materials cost data.
 4. Contractor's construction schedule (preliminary if not final).
 5. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 6. Products list (preliminary if not final).
 7. Sustainable design action plans.
 8. Schedule of unit prices.
 9. Submittal schedule (preliminary if not final).
 10. List of Contractor's staff assignments.
 11. List of Contractor's principal consultants.

12. Copies of building permits.
 13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 14. Initial progress report.
 15. Report of preconstruction conference.
 16. Certificates of insurance and insurance policies.
 17. Performance and payment bonds.
 18. Data needed to acquire Owner's insurance.
- I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. 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. Evidence that claims have been settled.
 8. 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.
 9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)**PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 29 00

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project meetings.
 - 5. Digital project management procedures.
- B. Related Requirements:
 - 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each principal portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. 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. Digital Coordination Drawings: Two-dimensional documents, such as schedules, shop drawings, product data, and general information, shall be submitted electronically in portable document format (PDF) file.
- C. Key Personnel Names: Within five days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.

- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Provide coordinated composite drawings, drawn at a scale not less than 1/4 inch per foot in both plan and elevation, including, but not limited to, equipment, ducts, pipe sleeves, piping including plumbing and sprinkler systems, lighting, special supports and other items contained within the space and finished ceiling. Show mechanical and electrical services and architectural and structural features drawn to scale. Provide composite drawings for corridors, specialty spaces, electrical rooms, communication rooms, mechanical rooms, shafts, tunnels, and other areas of limited space with complex systems. Distribute copies of composite drawings to all trades to assure a complete, coordinated installation of work within the space available. Include elevation drawings indicating finish ceiling heights, and heights above finished floor to bottom of ductwork, piping, conduit and other overhead fixtures and equipment.
 - 1) Sheet Size: At least 8-1/2-by-11-inch (215-by-280-mm) paper but no larger than 30 by 40 inches (760 by 1016 mm).
 - 2) Draw required details at a scale not less than 3/4 inch per foot.
 - 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.
 - 1) Scheduling, sequencing movement, and positioning of large equipment into the building during construction.

- 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.
 - h. Refer to Sections of Division 23 and Division 26 for specific Coordination Drawing requirements for mechanical and electrical installations.
 - i. Indicate relationship of components shown on separate Shop Drawings.
- 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. Designate fire-rated walls, partitions and floors.
 2. Mechanical and Electrical Rooms: Provide coordination drawings for mechanical and electrical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 3. Through Penetrations: Indicate fire-rated and non-fire-rated penetrations and openings required for all disciplines through interior and exterior walls, interior partitions, foundation walls, and floor slabs.
 4. 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.
 5. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, supply piping, sanitary, floor and roof drain piping, and conduit runs, including insulation, bracing, flanges, and support systems. Indicate access points and required maintenance areas.
 - b. Dimensions of major components, such as control boxes, dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 6. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, electrified door hardware, access controls, 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.
 7. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 8. Site Work: Show the following:

- a. Civil and electrical underground utilities, both new and existing.
 - b. Location of all building/site ground connections/rods.
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.
- 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.

1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified using the Submittal Exchange.
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 and Construction Manager.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect or AIA Document G716.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 26 00 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly, with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect and Construction Manager.
 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 and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven Insert number days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Web-Based Project Software: Use Construction Manager's web-based Project software site, "Submittal Exchange," for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project software site includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 2. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. 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, Construction Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long-lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. Preparation of record documents.
 - n. Use of the premises and existing building.
 - o. Work restrictions.
 - p. Working hours.
 - q. Owner's occupancy requirements.
 - r. Responsibility for temporary facilities and controls.
 - s. Procedures for moisture and mold control.
 - t. Procedures for disruptions and shutdowns.
 - u. Demolition and construction waste management.
 - v. Parking availability.
 - w. Office, work, and storage areas.
 - x. Equipment deliveries and priorities.
 - y. First aid.
 - z. Security.
 - aa. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Schedule and 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 and Construction Manager 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: Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Construction Manager, 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. Owner's partial occupancy requirements.
 - k. Installation of Owner's furniture, fixtures, and equipment.
 - l. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Construction Manager will conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site 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: Construction Manager will conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Construction Manager, 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) Sequence of finish installation.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.

- 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of correction of deficient items.
 - 15) Field observations.
 - 16) Requests for interpretations (RFIs).
 - 17) Status of Proposal Requests (PRs).
 - 18) Pending changes.
 - 19) Status of Change Orders.
 - 20) Pending claims and disputes.
 - 21) Documentation of information for payment requests.
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 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

- 1. Initial construction schedule.
- 2. Contractor's construction schedule.
- 3. Construction schedule updating reports.
- 4. Daily construction reports.
- 5. Material location reports.
- 6. Site condition reports.
- 7. Special reports.

- B. Related Requirements:

- 1. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports and for electronic submittal requirements.
- 2. Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file, where indicated.
 - 2. PDF electronic file.
- B. Initial construction schedule.
 - 1. Approval of cost-loaded, initial construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Initial Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.

4. Earnings Report: Compilation of Contractor's total earnings from Notice to Proceed until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at weekly intervals.
- H. Material Location Reports: Submit at weekly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Special Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 1. Review software limitations and content and format for reports.
 2. Verify availability of qualified personnel needed to develop and update schedule.
 3. Discuss constraints, including phasing, area separations, interim milestones, and partial Owner occupancy.
 4. Review delivery dates for Owner-furnished products.
 5. Review schedule for work of Owner's separate contracts.
 6. Review submittal requirements and procedures.
 7. Review time required for review of submittals and resubmittals.
 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 10. Review and finalize list of construction activities to be included in schedule.
 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate 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 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. Elevators.
 - b. Structural steel.
 - c. Modular bathrooms
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.

- d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
4. 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.
5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
- a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
- 1. Temporary enclosure and space conditioning.
 - 2. Completion of East Assisted Living Addition (Building A).
 - 3. Completion of Assisted Living Renovation and Addition (Building B).
 - 4. Completion of Community Space Upgrades (Building C).
 - 5. Completion of Independent Living Renovation and Elevator Addition (Building D).
 - 6. Completion of Specialty Care Assisted Living Facility (SCALF) Renovation (Building J).
 - 7. Completion of Short Term Stay Building (Building K)
 - 8. Completion of Long Term Care (LTC) Stand Alone (Building L).
- 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 01 29 00 "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 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 INITIAL CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit initial, horizontal, bar-chart-type construction schedule within 15 days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Initial Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the initial network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and commissioning.
 - j. Punch list and final completion.
 - k. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.

4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (see special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION**3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE**

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate final completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 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 01 31 00 "Project Management and Coordination" for submittal requirements using "Submittal Exchange."
 - 2. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 01 60 00 "Product Requirements" for administrative and procedural requirements for selection of products for use in Project.
 - 4. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 5. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 6. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager'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 and Construction Manager'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.

1.4 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 Construction Manager and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with initial construction schedule but prior to first application for payment. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Six-Week Look-Ahead Schedules: Maintain and update submittal schedules to reflect current conditions at the project site and project status. Submit revised submittal schedules highlighting the submittals planned in the subsequent six weeks.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Construction Manager's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Electronic Data: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals upon execution of AIA Document C106, Digital Data Licensing Agreement.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submittal items required for each Specification Section shall be submitted 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 and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 5. Arrange for preparation of required submittals in sufficient detail to permit analysis and review by Architect and Construction Manager, sufficiently early to allow for review, and accommodate the rate of construction progress required under the Contract. Delete or mark out extraneous material not relevant to the Project.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on the first full working day following Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 consecutive working days for initial review of each submittal. processing must be delayed to permit coordination with subsequent submittals or if concurrent review is required. Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination or concurrent review.
 2. Resubmittal Review: Allow 10 consecutive working days for review of each resubmittal.
 3. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 consecutive working days for initial review of each submittal.
 4. Concurrent Consultant Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 15 working days for initial review of each submittal. Submittal will be returned to Construction Manager, through Architect, before being returned to Contractor.
 - a. Submit to concurrent reviewer, Architect, and Construction Manager.
 5. Extended Review: Allow 20 consecutive working days for initial review of the following submittals:
 - a. Coordination drawings.
 - b. Windows.
 - c. Door hardware.
 - d. Electronic security systems.
 - e. HVAC temperature controls.
 - f. HVAC balancing report.
 - g. If more than five shop drawings of a single trade are received in one week.
- D. Electronic Submittals: Two-dimensional documents, such as schedules, shop drawings, product data, and general information, shall be submitted electronically in portable document format (PDF) file. Identify and incorporate information in each electronic 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., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.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 form acceptable to Owner, containing the following information:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Construction Manager.
 - e. Name of Contractor.
 - f. Name of firm or entity that prepared submittal.
 - g. Names of subcontractor, manufacturer, and supplier.
 - h. Category and type of submittal.
 - i. Submittal purpose and description.
 - j. Specification Section number and title.
 - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
 - l. Drawing number and detail references, as appropriate.
 - m. Location(s) where product is to be installed, as appropriate.
 - n. Related physical samples submitted directly.
 - o. Indication of full or partial submittal.
 - p. Transmittal number, numbered consecutively.
 - q. Submittal and transmittal distribution record.
 - r. Other necessary identification.
 - s. 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.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and Construction Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- G. Resubmittals: Make resubmittals in same form 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 and Construction Manager's action stamp.
- H. 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.
- I. 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 and Construction Manager'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. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website, "Submittal Exchange." Enter required data in web-based software site to fully identify submittal.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. 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.

2.2 ACTION SUBMITTALS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable. Delete or mark out extraneous material that is not applicable to the Work. Edit material to conform to project requirements, and to clearly show model number, type and size

- proposed. Provide additional information as necessary to supplement standard information.
3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's written recommendations.
 - d. Standard color charts.
 - e. Statement of compliance with specified referenced standards.
 - f. Testing by recognized testing agency.
 - g. Application of testing agency labels and seals.
 - h. Notation of coordination requirements.
 - i. 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. Mill reports.
 - e. Standard product operating and maintenance manuals.
 - f. Compliance with recognized trade association standards.
 - g. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. PDF electronic file.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shop fabrication instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - l. Notation of dimensions established by field measurement.
 - m. Relationship and attachment to adjoining construction clearly indicated.
 - n. Seal and signature of professional engineer if specified.

- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

2.3 INFORMATIONAL SUBMITTALS

- A. Contractor's Submittal Schedule: Comply with requirements specified in this Section under SUBMITTAL ADMINISTRATIVE REQUIREMENTS.
- B. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."
- C. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- D. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

- 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. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."
- G. 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.
- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
- I. Project Record Documents: Comply with requirements specified in Section 01 78 39, "Project Record Documents."
- J. Maintenance Data: Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."
- K. 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.
- L. 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.
- M. 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.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. 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.

- Q. 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.
- R. 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.
- S. 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.
- T. 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.
- U. 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.
- V. 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.

2.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic calculation files, 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 and Construction Manager.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "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.
 1. Architect and Construction Manager will take no action on submittals that have not been stamped and certified.

3.2 ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

- A. Action Submittals: Architect and Construction Manager will review each submittal, make marks to indicate corrections or revisions required, and return it. The review is for general conformance with the design concept and the information given in the construction documents. Corrections or comments made on the shop drawings/submittal during this review do not relieve Contractor from compliance with the requirements of the plans and specifications. Review of the specific item shall not include review of an assembly of which the item is a component. The contractor is responsible for: dimension to be confirmed and correlated at the job site; information that pertains solely to the fabrication processes or the means, methods, techniques, sequences and procedures of construction; coordination of the work with that of all other trades and performing all work in a safe and satisfactory manner.
- B. Construction Manager will stamp each submittal with an action stamp indicating review of submittal before forwarding to Architect.
- C. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
 1. **"No Exceptions Taken"** - When the Architect marks a submittal "No Exceptions Taken," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
 2. **"Make Corrections Noted"** - When the Architect marks a submittal "Make Corrections Noted," the Work covered by the submittal may proceed provided it complies with

- notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
3. **"Revise and Resubmit"** - When the Architect marks a submittal "Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 - a. Do not use, or allow others to use, submittals marked "Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.
 4. **"Rejected"** - When the Architect marks a submittal "Rejected," do not proceed with Work covered by the submittal. The Work covered by the submittal does not conform to the design concept or meet Contract Document requirements.
 - a. Do not use, or allow others to use, submittals marked "Rejected – Submit Specified Item" at the Project Site or elsewhere where Work is in progress.
 5. **"Submit Specified Item"** - When the Architect marks a submittal "Submit Specified Item," do not proceed with Work covered by the submittal. The Work covered by the submittal does not conform to the design concept or meet Contract Document requirements. Prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
 - a. Do not use, or allow others to use, submittals marked "Rejected – Submit Specified Item" at the Project Site or elsewhere where Work is in progress.
 6. **"Action Not Taken"** - Where a submittal is for information or record purposes or special processing or other activity, the Architect will return the submittal marked "Action Not Taken."
- D. Informational Submittals: Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
- E. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- F. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- G. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and 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, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect or Construction Manager.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups 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 are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
- D. Benchmarks: Samples that serve as standards by which other work may be measured or judged.

1. Approved benchmark samples shall use full scale, on-site surface areas and spaces. These shall be prepared using the complete specified or approved paint, coating, or decorative system. The sample shall include complete systems.
 2. Benchmark samples for interior coating systems shall be prepared only after permanent lighting, heating, venting and air conditioning equipment have been installed and activated.
 3. The condition of the surface to be used as the sample area shall be acceptable to the Architect prior to the preparation of the benchmark sample.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
1. 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).
- K. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 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. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

- C. Items indicated on the drawings but not included in the specifications, or included in the specifications and not indicated on the drawings, shall have the same effect as if indicated or included in both. In case of conflict or inconsistency between the drawings and the specifications, the Contractor shall additional information or interpretation as specified in Section 01 31 00 "Project Management and Coordination." Any adjustment by the Contractor without such determination shall be at its own risk and expense.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior 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.
- B. Qualification Data: For Contractor-engaged testing agencies 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.
- C. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Special Inspectors and Contractor's quality-control personnel.
- C. 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.
- D. Reports: Prepare and submit certified written reports and documents as specified.

- E. 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.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 15 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. 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.

1.8 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare 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.

1.9 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 for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade jurisdiction settlements and similar conventions.
- G. 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.
- H. 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.
- I. 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. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. 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, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. 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 or Construction Manager.
 2. Notify Architect or Construction Manager seven 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 and Construction Manager's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven 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. Demolish and remove mockups when directed unless otherwise indicated.
- K. Benchmarks: Benchmark samples shall be prepared to establish full scale, on-site surfaces to serve as standards by which subsequent work may be measured or judged. Each sample shall be prepared using the complete specified products, materials, or systems.

1.10 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 inspection they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

- 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. Engage a qualified testing agency to perform 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 24 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. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- D. 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 01 33 00 "Submittal Procedures."
- E. 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.
- F. 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.

- G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and 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.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated on Sheet S201 of the Structural Drawings, and as follows:
1. Information for the proposed special inspections firm shall be submitted to the Owner, Architect, and Structural Engineer for approval.
 2. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 3. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 4. 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.
 5. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 6. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 7. 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 01 73 00 "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 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the General Conditions of the Contract for Construction.
- 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.
 - 1. "Installer": Entity engaged by the Contractor, either as an employee or subcontractor, to perform an "Install" construction activity.
 - a. Installer shall be experienced in the operations they are engaged to perform.
 - 2. "Experienced Installer": Entity that has successfully completed a minimum of five previous projects similar in size and scope to this Project; is familiar with the special requirements indicated; and has complied with requirements of authorities having jurisdiction.
- H. "Provide": Furnish and install, complete and ready for the intended use.

- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Materials, equipment, and operations specified by reference to published standards and specifications of a technical society, trade association, or other agency standard, shall comply with the requirements of the current edition of the listed document that is in effect on the issue date of the Specifications or Addendum page making reference thereto, unless otherwise specified. Make available at site, copies of referenced documents as Owner's Representative or Architect may request.
 1. No Provision of a reference standard, specification, manual, or code shall be effective to change the duties and responsibilities of the Owner, the Contractor, the Architect and their consultants, their agents and employees from those duties and responsibilities set forth in the Contract Documents.
- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
 1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 2. ICC - International Code Council; www.iccsafe.org.
 3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
3. DOD - Department of Defense; www.quicksearch.dla.mil.
4. DOE - Department of Energy; www.energy.gov.
5. EPA - Environmental Protection Agency; www.epa.gov.
6. FG - Federal Government Publications; www.gpo.gov.
7. HUD - Department of Housing and Urban Development; www.hud.gov.
8. OSHA - Occupational Safety & Health Administration; www.osha.gov.
9. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
10. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
11. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
12. USPS - United States Postal Service; www.usps.com.

E. 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. FED-STD - Federal Standard; (See FS).
3. 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.
4. MILSPEC - Military Specification and Standards; (See DOD).
5. USAB - United States Access Board; www.access-board.gov.
6. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. ADPH: Alabama Department of Public Health

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.3 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, occupants of Project, 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.
- 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

- D. **Moisture-Protection Plan:** Describe procedures and controls for protecting materials and construction from water absorption and damage.
1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
- E. **Dust- and HVAC-Control Plan:** Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
1. Locations of dust-control partitions at each phase of work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air-filtration system discharge.
 4. Waste-handling procedures.
 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. **Electric Service:** Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. **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.

1.6 PROJECT CONDITIONS

- A. **Temporary Use of Permanent Facilities:** Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. **Chain-Link Fencing:** Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.

- B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- C. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).
- D. 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: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- 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 01 77 00 "Closeout Procedures".
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
 1. Water Service: Access to Owner's existing water service facilities may be allowed at the discretion of the Owner. Water service facilities shall be cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, these facilities shall be restored 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.
 1. Toilets: Use of Owner's existing toilet facilities may be permitted at the discretion of the Owner. If permitted, facilities shall be cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, these facilities shall be restored to condition existing before initial use.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- 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. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- H. Electric Power Service: Connect to Owner's existing electric power service provided the service is of sufficient size, capacity, and power characteristic required for construction operations. Maintain equipment in a condition acceptable to Owner.
1. If required, install electric power service overhead unless otherwise indicated.
- I. 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.
- J. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect 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 Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas as indicated on the Drawings.
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- 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. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

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.
1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
1. Comply with work restrictions specified in Section 01 10 00 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
1. Extent of Fence: As indicated on Drawings.
 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
 2. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
 3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 4. Insulate partitions to control noise transmission to occupied areas.
 5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 6. Protect air-handling equipment.
 7. Provide walk-off mats at each entrance through temporary partition.
- M. 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. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.

2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 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 office spaces, 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. At Substantial Completion, restore Owner-allocated office spaces to condition existing before initial use,
 2. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
1. Where applicable, materials and construction shall be in accordance with the City of Edmond Standard Specifications for Construction (Standard Specifications) and Construction Standards.
- B. Related Requirements:
1. Section 01 42 00 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products or equipment which will be exposed to view in occupied spaces or on the exterior.
1. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface that is not conspicuous.
 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on accessible, but inconspicuous, surface in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00 "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.
- B. Provide materials and equipment that are of good quality and new, unless otherwise specified, are free from faults and defects not inherent in the quality required, that conform with requirements of Contract Documents, that are suitable for use and function intended, that are corresponding in quality to related materials in the absence of a complete specification, that are of quality appearance where exposed to view, that are of one manufacturer or source for the same specific purpose, with uniform appearance and physical properties, and that are identical and interchangeable when required in quantity
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. The Architect is solely responsible for evaluation of products and manufacturers submitted as "Or equal" to the specified product or manufacturer.
 - b. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect, whose determination is final.
- C. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements.
 - 1) Comparable products will be considered unless otherwise indicated.
 - 2) Substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - 1) Comparable products will be considered unless otherwise indicated.
 - 2) Substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- D. 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 01 25 00 "Substitution Procedures" for proposal of product.

- E. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
1. Construction layout.
 2. Field engineering and surveying.
 3. Installation of the Work.
 4. Cutting and patching.
 5. Progress cleaning.
 6. Starting and adjusting.
 7. Protection of installed construction.
- B. Related Requirements:
1. Section 01 10 00 "Summary" for limits on use of Project site.
 2. Section 01 31 00 "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 3. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 4. Section 01 74 49 "Construction Waste Management and Disposal" for administrative and procedural requirements for disposal and salvaging of nonhazardous demolition and construction waste.
 5. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. 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.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

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 local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels as needed to locate each element of Project.
 2. Establish limits on use of Project site.
 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 4. Inform installers of lines and levels to which they must comply.
 5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, and column grids, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, reference points, stakes, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Except where more stringent requirements are specified, prepare, install, test, adjust and clean products, materials and equipment in accordance with manufacturer's printed instructions, recommendations and limitations for conditions indicated. Provide recommended accessory materials for a complete installation. If conflict exists between job conditions or specified requirements and with manufacturer's instructions, request written clarification from Architect before proceeding.
- 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. Coordination of Space: Where space is limited, install components and systems to maximize space available for maintenance and ease of removal for replacement.
- F. Concealed Work: In finished areas, except as otherwise indicated, conceal pipes, ducts, conduit and wiring in the finished construction. Coordinate locations of fixtures, outlets, access panels, and similar items with finish elements. Provide escutcheon plates at penetrations through finished walls, ceilings and floors, with finish appropriate to adjacent finished surface.
- G. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- H. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- I. 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.

- J. 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.
- K. 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.
- L. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 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 01 10 00 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. 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.

3.7 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 (27 deg C).
 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 01 74 49 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to 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. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Excessive winds.
5. Thermal shock.
6. Excessively high or low humidity.
7. Pollution and air contamination.
8. Water or ice.
9. Chemicals and solvents.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining, and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High-speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft or vandalism.

3.8 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 01 40 00 "Quality Requirements."

3.9 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.
- C. Owner reserves the right to protect installed Work to prevent damage and deterioration if the Contractor fails to protect the installed Work in a proper manner. The costs incurred by the Owner shall be paid by the Contractor.

END OF SECTION 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 04 20 00 "Unit Masonry" for disposal requirements for masonry waste.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste for deposit in landfill or designated spoil areas on Owner's property.
- 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.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice of Award.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons (tonnes).
 - 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
- B. 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.
- C. Qualification Data: For waste management coordinator.
- D. 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.
- E. Refrigerant Recovery: Comply with requirements in Section 02 41 19 "Selective Demolition" for refrigerant recovery submittals.

1.7 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- B. Preconstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 02 41 19 "Selective Demolition."
 - 2. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate salvage of materials.

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 01 50 00 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Construction Manager's Superintendent will coordinate implementation, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage and disposal.
- D. 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.
 2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 02 41 19 "Selective Demolition" for salvaging demolition waste.
- B. 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.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.

- H. 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, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

END OF SECTION 01 74 19

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SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for administrative submittal requirements and electronic submittal requirements.
 - 2. Section 01 73 00 "Execution" for progress cleaning of Project site.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Section 01 79 00 "Demonstration and Training" for requirements for instructing Owner's personnel.
 - 6. Sections of Divisions 21 through 28 for specific closeout requirements relate to mechanical, electrical and plumbing systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items (Punch List): Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items (Punch List): Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.

- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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 working 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 Owner. 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 Construction Manager'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 working days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. 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 working days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager 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 Punch List 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.
- E. Architect's Inspection for Substantial Completion: Except with the consent of the Owner, the Architect will perform no more than 2 inspections to determine whether the Work or a designated portion thereof has attained Substantial Completion in accordance with the Contract Documents.
1. The Owner will be entitled to deduct from the Contract Sum amounts paid to the Architect for any additional inspections.
 - a. Cost of the Architect's additional services will be calculated in accordance with the hourly rates included in the Agreement between Owner and Architect.
 - b. Architect will issue a deduct Change Order in the amount of Architect's additional services.
 - c. Owner will deduct the amount of Architect's additional services from final payment to Contractor.

1.7 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.
 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. Final version of the Punch List shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 working days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager 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.

1.8 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 or a form acceptable to the Architect.
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 and Construction Manager .
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. PDF electronic file. Architect, through Construction Manager, will return annotated file.

1.9 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 working 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. 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.
 - 1. Designate specific warranties that will be included in operation and maintenance manuals
- 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. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

- h. Sweep concrete floors broom clean in unoccupied spaces.
- i. Clean ceramic tile walls and floors.
- j. Clean, buff and wax resilient floors.
- k. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- l. 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.
- m. Remove labels that are not permanent.
- n. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- o. Clean plumbing fixtures, accessories, and trim to a sanitary condition, free of stains, including stains resulting from water exposure.
- p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- s. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements established by Construction Manager.

D. Pest Control: Comply with pest control requirements established by Construction Manager. Prepare written report.

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 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 01 77 00

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SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. 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. Initial Manual Submittal: Submit electronic draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 working days before commencing demonstration and training. Architect will return copy with comments.
 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 working days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

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. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 "Project Record Documents."
- G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for electronic submittal requirements.
 - 2. Section 01 73 00 "Execution" for final property survey.
 - 3. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 4. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 5. Sections in Divisions 02 through 49 for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Submit PDF electronic files of scanned record documents to the Owner. Include all documents, whether changes were made or not.
 - a. Final Submittal: Submit PDF electronic files of scanned record prints, including one set of prints with no changes.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

- D. 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.
- E. 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 ELECTRONIC DATA

- A. Electronic Data: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals upon execution of AIA Document C106, Digital Data Licensing Agreement.

2.2 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations 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 and Construction Manager. 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 through Construction Manager for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. 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 data file sets.
 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 and Construction Manager.
- e. Name of Contractor.

2.3 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: Submit record Specifications as annotated PDF electronic file.

2.4 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: Submit record Product Data as annotated PDF electronic file.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.5 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: Submit miscellaneous record submittals as PDF electronic file.
 - 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 and Construction Manager's reference during normal working hours.

END OF SECTION 01 78 39

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SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two 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 and address of videographer.
 - c. Name of Architect.

- d. Name of Contractor.
 - e. Date of video recording.
2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 3. 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.
 4. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "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.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data 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.
 - h. Performance curves.
 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 01 78 23 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. 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.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written performance-based test.
- F. 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. General: Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the

following for each Contractor involved on the Project, arranged according to Project table of contents:

- a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.
- E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- F. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 01 79 00

SECTION 02 41 19 - SELECTIVE DEMOLITION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 01 73 00 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse [**store**].
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.
- E. 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.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Universal certified by EPA-approved certification program.

1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

- B. Review 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. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. 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.
 - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 POLLUTION CONTROLS

- A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.
 - 1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
 - 2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.
- B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.6 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.7 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section **<Insert Section number and title>** for new roofing requirements.
 - 1. Remove existing roof membrane, flashings, copings, and roof accessories.
 - 2. Remove existing roofing system down to substrate.

3.8 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.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

3.9 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.10 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: <Insert description of items and construction to remove>.
- B. Remove and Salvage: <Insert description of items to remove and salvage>.
- C. Remove and Reinstall: <Insert description of items to remove and reinstall>.
- D. Existing to Remain: <Insert description of items to remain>.
- E. Dismantle: <Insert description of items to be removed>.

END OF SECTION 02 41 19

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Requirements:
 - 1. Section 03 33 00 "Architectural Concrete" for general building applications of specially finished formed concrete.
 - 2. Section 31 20 00 "Earth Moving" for drainage fill under slabs-on-grade.
 - 3. Section 32 13 13 "Concrete Paving" for concrete pavement and walks.

1.3 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.

1.4 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. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish 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, 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, concrete repair procedures, and concrete protection.

1.5 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.
- 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 waterstops and vapor retarder.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- 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. Fiber reinforcement.
 - 5. Waterstops.
 - 6. Curing compounds.
 - 7. Floor and slab treatments.
 - 8. Bonding agents.
 - 9. Adhesives.
 - 10. Vapor retarders.
 - 11. Semirigid joint filler.
 - 12. Joint-filler strips.
 - 13. Repair materials.
- 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. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/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 conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. 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. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.
- E. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 1. Build panel approximately 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
 2. 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. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

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 (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 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 (ACI 301M) and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

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 (ACI 301M).
 2. ACI 117 (ACI 117M).

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.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that 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.
- E. 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 (25 mm) to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- C. 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 (Grade 420), 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.

2.5 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/II, gray or white as indicated.
 2. Fly Ash: ASTM C 618, Class F or C.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3M 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: 3/4 inch (19 mm) nominal.
 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. 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.
- F. Water: ASTM C 94/C 94M and potable.

2.6 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. CETCO, a Minerals Technologies company.
 - c. Henry Company.
 - d. Sika Greenstreak.
 2. Profile: Ribbed with center bulb.
 3. Dimensions: 9 inches by 3/8 inch thick (225 mm by 10 mm thick); nontapered.
- B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. CETCO, a Minerals Technologies company.
 - c. Henry Company.
 - d. Sika Greenstreak.

2.7 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape; minimum 10 mils thick.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. GCP Applied Technologies Inc. (formerly Grace Construction Products).
 - b. Raven Industries, Inc.
 - c. Stego Industries, LLC.
 - d. W. R. Meadows, Inc.

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Admixture Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. L&M Construction Chemicals, Inc.
 - d. SpecChem, LLC.
 - e. Vexcon Chemicals Inc.
 - f. W. R. Meadows, Inc.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anti-Hydro International, Inc.
 - b. BASF Corporation; Admixture Systems.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. L&M Construction Chemicals, Inc.
 - e. SpecChem, LLC.
 - f. Vexcon Chemicals Inc.
 - g. W. R. Meadows, Inc.
- F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. BASF Corporation; Admixture Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. L&M Construction Chemicals, Inc.
 - d. SpecChem, LLC.
 - e. Vexcon Chemicals Inc.
 - f. W. R. Meadows, Inc.
- G. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Euclid Chemical Company (The); an RPM company.
 - b. L&M Construction Chemicals, Inc.
 - c. SpecChem, LLC.
 - d. Vexcon Chemicals Inc.
 - e. W. R. Meadows, Inc.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges 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 underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi (29 MPa) 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 (6.4 mm) 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 (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.11 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 (ACI 301M).
1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash: 20 percent or 100 pounds, whichever is less.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.
5. Aggregates shall be proportioned such that mix design shall contain a minimum of 50 percent coarse aggregate per the gradation requirements specified in ASTM C33/C33M.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.
5. Aggregates shall be proportioned such that mix design shall contain a minimum of 50 percent coarse aggregate per the gradation requirements specified in ASTM C33/C33M.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 540 lb/cu. yd. (320 kg/cu. m).
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
6. Aggregates shall be proportioned such that mix design shall contain a minimum of 50 percent coarse aggregate per the gradation requirements specified in ASTM C33/C33M.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
2. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION**3.1 FORMWORK INSTALLATION**

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), 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 (ACI 117M).
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. 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. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED 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.
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (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 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.
- B. 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.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 (ACI 318M) and ACI 301 (ACI 301M) for design, installation, and removal of shoring and reshoring.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 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.
- 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.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls at maximum 60 feet (18.3 m) on center.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete

when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/4 inch (6.5 mm) or more than 1/2 inch (13 mm) below finished concrete surface where joint sealants, specified in Section 07 92 00 "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.

3.8 WATERSTOP INSTALLATION

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by 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 (ACI 301M).
 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 (150 mm) into preceding layer. Do not insert vibrators into lower layers of

concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
1. Apply to concrete surfaces exposed to public view.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

- A. General: Comply with 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.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, paint, or another thin-film-finish coating system.
 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.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated 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: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.12 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 (100 mm) high unless otherwise indicated, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.13 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. 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, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. **Moisture-Retaining-Cover Curing:** Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
3. **Curing Compound:** Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. **Removal:** After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
4. **Curing and Sealing Compound:** Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 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. 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 (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.15 CONCRETE SURFACE REPAIRS

- A. **Defective Concrete:** Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) 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 (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). 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 (0.25 mm) 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 (6 mm) 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 (25 mm) 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 (19-mm) 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.

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- 7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
 - E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
 - F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

- A. Special Inspections: Contractor shall engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports as indicated on Sheet S201 of the Project Structural Drawings.
- B. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

END OF SECTION 03 30 00

SECTION 03 33 00 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place architectural concrete, including form facings, reinforcement and accessories, concrete materials, concrete mixture design, placement procedures, and finishes.
 - 1. Requirements in Section 03 30 00 "Cast-in-Place Concrete" apply to architectural concrete.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for concrete not designated as architectural concrete.

1.3 DEFINITIONS

- A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. 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.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.
- E. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:

- a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place architectural concrete Subcontractor.
2. Review concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.
 3. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials.

1.5 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.
- C. Formwork Shop Drawings: Show formwork construction, including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
- D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints, including construction joints.
- E. Samples: For each of the following materials:
 1. Form-facing panels.
 2. Form ties.
 3. Form liners.
 4. Exposed aggregates.
 5. Coarse- and fine-aggregate gradations.
 6. Chamfers and rustications.
- F. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches (450 by 450 by 50 mm), of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Repair materials.
- C. Material Test Reports: For the following, by a qualified testing agency:
1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be an 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.
- C. 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 (1200 by 1200 by 150 mm) 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.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

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 (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 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.
 4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:
1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

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 (ACI 301M).
 2. ACI 303.1.

2.2 FORM-FACING MATERIALS

- A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for formwork and other form-facing material requirements.
- B. Source Limitations: Obtain each type form-facing material from single source from single manufacturer.
- C. Form-Facing Panels for As-Cast Finishes: Exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural concrete surfaces, high-density overlay, Class 1, or better, complying with DOC PS 1.
- D. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that provide surfaces with gradual or abrupt irregularities not exceeding

- specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- F. Rustication Strips: Dressed wood or rigid plastic, or with sides beveled and back kerfed; nonstaining; in longest practicable lengths.
- G. Chamfer Strips: Dressed wood, 3/4 by 3/4 inch (19 by 19 mm), minimum; nonstaining; in longest practicable lengths.
- H. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch (6 mm) thick.
- I. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. BASF Corporation; Construction Systems.
- J. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.
- K. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 2. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- L. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. BASF Corporation; Construction Systems.
- M. Form Ties: Factory-fabricated, glass-fiber-reinforced plastic, internally disconnecting, or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish ties with tapered tie cone spreaders that, when removed, will leave holes 1 inch (25 mm) in diameter on concrete surface.
2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm) from the architectural concrete surface.
3. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) in diameter, of color selected by Architect from manufacturer's full range.
4. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice."
 1. Where legs of wire bar supports contact forms, use CRSI Class 1, gray, plastic-protected bar supports.

2.4 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, gray or white as indicated.
 2. Fly Ash: ASTM C 618, Class C or F.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 5S coarse aggregate or better, graded. Provide aggregates from 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: 3/4 inch (19 mm).
 2. Gradation: Uniformly graded.
- D. Normal-Weight Fine Aggregate: ASTM C 33/C 33M or ASTM C 144, manufactured or natural sand, from same source for entire Project.
- E. Air-Entraining Admixture: ASTM C 260/C 260M.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Euclid Chemical Company (The); an RPM company.

- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that does 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.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) BASF Corporation; Construction Systems.
 - 2) Euclid Chemical Company (The); an RPM company.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) BASF Corporation; Construction Systems.
 - 2) Euclid Chemical Company (The); an RPM company.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) BASF Corporation; Construction Systems.
 - 2) Euclid Chemical Company (The); an RPM company.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) BASF Corporation; Construction Systems.
 - 2) Euclid Chemical Company (The); an RPM company.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
- 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. BASF Corporation; Admixture Systems.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. QC Construction Products.
 - d. Scofield, L. M. Company.
 2. Color: As selected by Architect from manufacturer's full range.

- H. Water: Potable, complying with ASTM C 94/C 94M, except free of wash water from mixer washout operations.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anti-Hydro International, Inc.
 - b. BASF Corporation; Admixture Systems.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. L&M Construction Chemicals, Inc.
 - e. W. R. Meadows, Inc.
 2. For integrally colored concrete, curing compound shall be pigmented type approved by color pigment manufacturer.
 3. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.6 REPAIR MATERIALS

- A. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- 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 and of grade to suit requirements.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. BASF Corporation; Construction Systems.
 2. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

- B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).
 - 1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
- C. Cementitious Materials: For cast-in-place architectural concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 (ACI 301M) requirements. Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- E. Admixtures: Use admixtures according to manufacturer's written instructions.
- F. 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.
- G. Concrete Mixtures:
 - 1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
 - 2. Maximum W/C Ratio: 0.46.
 - 3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
 - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19-mm) nominal maximum aggregate size.

2.8 CONCRETE MIXING

- A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
 - 1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
 - 2. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

- A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.
- B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

- C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch (3 mm).
- D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117 (ASI 117M).
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.
 - 1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
 - 2. Do not use rust-stained steel form-facing material.
- F. 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.
- G. Chamfer exterior corners and edges of cast-in-place architectural concrete.
- H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.
- N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form-liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 REINFORCEMENT AND INSERT INSTALLATION

- A. General: Comply with Section 03 30 00 "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

- B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

- A. 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 if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Schedule form removal to maintain surface appearance that matches approved field sample panels.
 - 2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 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. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. 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 cast-in-place architectural concrete surfaces.

3.4 JOINTS

- A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural 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.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use bonding agent or epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
 - 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 (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

3.6 FINISHES, GENERAL

- A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- B. 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.
 - 1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

- 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 exceeding specified limits on formed-surface irregularities.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.

- C. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

3.8 EXPOSED-AGGREGATE FINISHES

- A. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi (6.9 to 10.3 MPa), 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 (31 MPa). 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 (13.8 MPa). 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 (1.5 mm).
 - c. Medium: Generally expose coarse aggregate; with slight reveal, a maximum of 1/4 inch (6 mm).
 - 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 (6 to 13 mm).
- 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.

3.9 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural concrete immediately after removing forms from concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
 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 (300-mm) lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Mist concrete surfaces with water. Apply curing compound 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.

3.10 FIELD QUALITY CONTROL

- A. General: Comply with field quality-control requirements in Section 03 30 00 "Cast-in-Place Concrete."

3.11 REPAIR, PROTECTION, AND CLEANING

- A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.
 1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.
- B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.
- C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.
- D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
- E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 03 33 00

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SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Field-installed shear connectors.
 - 3. Grout.
- B. Related Requirements:
 - 1. Section 05 31 00 "Steel Decking" for field installation of shear connectors through deck.
 - 2. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
 - 3. Section 09 91 00 "Painting" for surface-preparation and priming requirements.

1.3 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."

1.4 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.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 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.
- C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, and testing agency.
- 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. Shear stud connectors.
 - 4. Shop primers.
 - 5. Nonshrink grout.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or Endorsement P2 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC 303.
 - 2. AISC 341 and AISC 341s1.
 - 3. AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated.
 - 2. Use Allowable Stress Design; data are given at service-load level.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.

- B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B or Grade C, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
 - 1. Weight Class: Standard.
 - 2. Finish: Black except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- C. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 - 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 - 4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 - 5. Finish: Plain.

2.4 PRIMER

- A. Primer: Comply with Section 09 91 00 "Painting."

2.5 GROUT

- 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.

2.6 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, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- E. 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.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

2.7 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.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces 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.
- 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 11, "Power Tool Cleaning to Bare Metal" or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
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.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 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 and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: 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. 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.
- 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.

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.
- 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.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates: 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 Architect. 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.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 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. 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. Contractor shall engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports as indicated on Sheet S201 of the Structural Drawings.

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 Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

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SECTION 05 50 00 - METAL FABRICATIONS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Steel framing and supports for countertops.
 2. Steel tube reinforcement for low partitions.
 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 4. Shelf angles.
 5. Metal ladders.
 6. Metal bollards.
 7. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.
 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
- C. Related Requirements:
1. Section 03 30 00 "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 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
 3. Section 05 12 00 "Structural Steel Framing."

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written 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 or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Nonslip aggregates and nonslip-aggregate surface finishes.
 2. Prefabricated building columns.
 3. Metal nosings and treads.
 4. Paint products.
 5. 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 overhead doors.
 2. Steel framing and supports for countertops.
 3. Steel tube reinforcement for low partitions.
 4. Steel framing and supports for mechanical and electrical equipment.
 5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 6. Shelf angles.
 7. Metal ladders.
 8. Metal bollards.
 9. Loose steel lintels.
- C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 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."

1.7 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. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.
- B. 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 (67 deg C), ambient; 180 deg F (100 deg C), 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: As indicated.
 - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 (Z275) coating; minimum 0.079-inch (2-mm) nominal thickness.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

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 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. 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.
- E. 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.
- F. 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 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 09 91 00 "Painting."
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- D. 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.
- E. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

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 (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports unless otherwise indicated.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

- A. General:
 - 1. Comply with ANSI A14.3.
 - 2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:
 - 1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
 - 2. Siderails: Continuous, 1/2-by-2-1/2-inch (12.7-by-64-mm) steel flat bars, with eased edges.
 - 3. Rungs: 1-inch- (25-mm-) diameter steel bars.
 - 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 - 6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Harsco Industrial IKG, a division of Harsco Corporation.
 - 2) SlipNOT Metal Safety Flooring; W.S. Molnar Company.
 - 7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
 - 8. Galvanize and prime ladders, including brackets.
 - 9. Prime ladders with primer specified in Section 09 91 00 "Painting."

2.9 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime miscellaneous steel trim.
- D. Prime miscellaneous steel trim with primer specified in Section 09 91 00 "Painting."

2.10 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 - 1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 - 2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Prime bollards with primer specified in Section 09 91 00 "Painting."

2.11 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.12 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

2.13 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.

2.14 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.

2.15 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 iron and steel items 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 primers specified in Section 09 91 00 "Painting" unless indicated.
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION**3.1 INSTALLATION, GENERAL**

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
 2. Extruded Aluminum: Two coats of clear lacquer.

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. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.
- C. 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.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

- A. Anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.
1. Embed anchor bolts at least 4 inches (100 mm) in concrete.

- B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm) toward bollard.
- C. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- D. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 1. Do not fill removable bollards with concrete.

3.4 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.

3.5 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 (0.05-mm) 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 09 91 00 "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 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
 - 2. Fittings and brackets.
 - 3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

- a. Show method of connecting and finishing members at intersections.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- E. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Wagner, R & B, Inc.

- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed).
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish unless otherwise indicated.

- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- E. Expanded Metal: ASTM F 1267, Type II (expanded and flattened), Class 1 (uncoated).
 - 1. Style Designation: 3/4 number 13.
- F. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, 0.060 inch (1.52 mm) thick, with 1/4-inch (6.4-mm) holes 3/8 inch (9.5 mm) o.c. in staggered rows.
- G. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.134-inch- (3.42-mm-) diameter wire complying with ASTM A 510 (ASTM A 510M).

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- C. 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.
- D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form Changes in Direction as Follows:
1. As detailed.
- J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch (1.1 mm) thick.
- P. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch (1.1 mm) thick.
 2. Orient perforated metal with pattern horizontal.
- Q. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
1. Orient wire mesh with wires horizontal and vertical.

- R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- D. Primer Application: Apply shop primer to prepared galvanized surfaces of railings. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

- E. Shop-Painted Finish: Comply with Section 09 91 13 "Exterior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.

- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

- A. Touchup Primer: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop applied primer, and prime exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 requirements for touching up shop-primed surfaces.
 - 1. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

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SECTION 06 10 00 - ROUGH CARPENTRY**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.
2. Wood blocking, cants, and nailers.
3. Wood furring and grounds.
4. Wood sleepers.
5. Plywood backing panels.

B. Related Requirements:

1. Section 06 17 53 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.
2. Section 31 31 16 "Termite Control" for site application of borate treatment to wood framing.

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.

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.

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.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.
- C. 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: AWP A 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.
- 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.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 3. 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 (3.2 m) 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.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
 - 7. Utility shelving.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 3 grade; SPIB.
 - 2. Hem-fir or hem-fir (north); Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or spruce-pine-fir; Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - 4. Eastern softwoods; No. 3 Common grade; NeLMA.
 - 5. Northern species; No. 3 Common grade; NLGA.
 - 6. Western woods; Standard or No. 3 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, C-C Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 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 with hot-dip zinc coating complying with ASTM A 153/A 153M.
- 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.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC193 as appropriate for the substrate.
1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).
- B. 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.
- C. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION**3.1 INSTALLATION, GENERAL**

- A. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

- B. 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.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install shear wall panels to comply with manufacturer's written instructions.
- E. 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 (406 mm) o.c.
- F. 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.
- G. Comply with AWWA 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.
- H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. ICC-ES evaluation report for fastener.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) 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.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally at 24 inches (610 mm) o.c.
- C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 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.
- B. 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 06 10 00

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SECTION 07 21 00 - THERMAL INSULATION**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket.
 - 3. Glass-fiber board.
 - 4. Loose-fill insulation.
- B. Related Requirements:
 - 1. Section 04 20 00 "Unit Masonry" for insulation installed in masonry cells.
 - 2. Section 07 24 19 "Water-Drainage Exterior Insulation and Finish System (EIFS)" for rigid insulation board installed with exterior finish system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded Polystyrene Board, Type VII: ASTM C 578, Type VII, 60-psi (414-kPa) minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.

2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Owens Corning.

2.3 GLASS-FIBER BOARD

- A. Glass-Fiber Board, Unfaced: 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. Nominal density of 2.25 lb/cu. ft (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. Knauf Insulation.
 - d. Owens Corning.

2.4 LOOSE-FILL INSULATION

- A. Cellulosic-Fiber Loose-Fill Insulation: ASTM C 739, chemically treated for flame-resistance, processing, and handling characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Central Fiber LLC.
 - b. Hamilton Manufacturing Inc.
- B. Glass-Fiber Loose-Fill Insulation: ASTM C 764, Type II for poured application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

2.5 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C 1149, Type III (materials containing an adhesive mixed with water during application; intended for application on attic floors), chemically treated for flame-resistance, processing, and handling characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Central Fiber LLC.
 - b. Hamilton Manufacturing Inc.
 - c. International Cellulose Corp.

2.6 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.
- B. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

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.
- 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 vertical slab edge and foundation 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 (915 mm) below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 - 1. If not otherwise indicated, extend insulation a minimum of 36 inches (915 mm) in from exterior walls.

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. 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 (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 - 5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
- C. Loose-Fill Insulation: Apply according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
- D. Spray-Applied Cellulosic 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 studs by using method recommended by insulation manufacturer.

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 07 21 00

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SECTION 07 24 19 - WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)**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. EIFS-clad drainage-wall assemblies that are field applied over masonry substrate.
 - 2. Water-resistive barrier coatings.

1.3 DEFINITIONS

- A. Definitions in ASTM E 2110 apply to Work of this Section.
- B. EIFS: Exterior insulation and finish system(s).
- C. IBC: International Building Code.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each EIFS component, trim, and accessory, including water-resistive barrier coatings.
- B. Shop Drawings:
 - 1. Include details for EIFS buildouts.
- C. Samples: For each exposed product and for each color and texture specified, 8 inches (200 mm) square in size.
- D. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
 - 1. Include similar Samples of exposed accessories involving color selection.

- E. Samples for Verification: 24-inch- (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work, including custom trim, each profile, and an aesthetic reveal.
 - 1. Include exposed trim and accessory Samples to verify color selected.
 - 2. Include a typical control joint filled with sealant of color selected, as specified in Section 07 92 00 "Joint Sealants."

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by EIFS manufacturer, certifying the following:
 - 1. EIFS complies with requirements.
 - 2. Substrates to which EIFS is indicated to be attached are acceptable to EIFS manufacturer.
 - 3. Accessory products installed with EIFS, including joint sealants, flashing, water-resistive barrier coatings, and trim, whether or not furnished by EIFS manufacturer and whether or not specified in this Section, are acceptable to EIFS manufacturer.
- C. Product Certificates: For cementitious materials and aggregates and for insulation and joint sealant, from manufacturer.
- D. Product Test Reports: For each EIFS assembly and component, and for water-resistive barrier coatings, for tests performed by a qualified testing agency.
- E. Field quality-control reports.
- F. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For EIFS to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An installer who is certified in writing by AWCI International as qualified to install Class PB EIFS using trained workers.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.
- B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1. Stack insulation board flat and off the ground.
2. Protect plastic insulation 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.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.
1. Proceed with installation of adhesives or coatings only when ambient temperatures have remained, or are forecast to remain, above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after application. Do not apply EIFS adhesives or coatings during rainfall.

1.11 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Bond integrity and weathertightness.
 - b. Deterioration of EIFS finishes and other EIFS materials beyond normal weathering.
 2. Warranty coverage includes the following components of EIFS-clad drainage-wall assemblies:
 - a. EIFS finish, including base coats, finish coats, and reinforcing mesh.
 - b. Insulation installed as part of EIFS including foam buildouts.
 - c. Insulation adhesive.
 - d. EIFS accessories, including trim components and flashing.
 - e. Water-resistive barrier coatings.
 - f. EIFS drainage components.
 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sto Corp; StoTherm "ci - Classic" System A100G or comparable product by one of the following:

1. BASF Corporation; Wall Systems.
 2. Dryvit Systems, Inc.
 3. Parex USA, Inc.
 4. Senergy; BASF Corp.
- B. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with EIFS components.

2.2 PERFORMANCE REQUIREMENTS

- A. EIFS Performance: Comply with ASTM E 2568 and with the following:
1. Weathertightness: Resistant to uncontrolled water penetration from exterior, with a means to drain water entering EIFS to the exterior.
 2. Structural Performance of Assembly and Components:
 - a. Wind Loads: Uniform pressure as indicated on Drawings.
 3. Surface Burning Characteristics: Individual components shall each have a flame spread of 25 or less, and smoke developed of 450 or less according to ASTM E 84.
 4. Impact Resistance: ASTM E 2486, High impact resistance, 90 to 150 inch-lb (10.2 to 17J).
 5. Water Penetration: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes at 6.24 psf (299 Pa) according to ASTM E 331.
 6. Abrasion Resistance of Finish Coat: Sample consisting of 1-inch- (25.4-mm-) thick EIFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for a minimum of 28 days and shows no cracking, checking, or loss of film integrity after exposure to 528 quarts (500 L) of sand when tested according to ASTM D 968, Method A.
 7. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch (50.8-by-50.8-mm) clean glass substrate; cured for 28 days and shows no growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274.
 8. Alkali Resistance of Reinforcing Mesh: Greater than 120 pli (21 dN/cm) retained tensile strength according to ASTM E 2098.
 9. Drainage Efficiency: 90 percent average minimum when tested according to ASTM E 2273.

2.3 EIFS MATERIALS

- A. Water-Resistive Air Barrier Coating: EIFS manufacturer's standard formulation and accessories for use as water-resistive barrier coating; compatible with substrate.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Sto Corp; StoTherm StoGuard Waterproof Air Barrier or comparable product by one of the other specified manufacturers.
 2. Water-Resistance: Comply with physical and performance criteria of ASTM E 2570/E 2570M.

- B. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt, and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.
- C. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; specifically formulated to be applied to back side of insulation in a manner that creates open vertical channels designed to serve as an integral part of the water-drainage system of the EIFS-clad drainage-wall assembly; compatible with substrate; and complying with the following:
1. Factory-blended dry formulation of portland cement, dry polymer admixture, and fillers specified for base coat.
- D. Expanded Rigid Cellular Polystyrene Board Insulation: Comply with ASTM E 2430/E 2430M and ASTM C 578 Type I, unless otherwise noted, and the following:
1. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, according to ASTM E 84.
 2. Dimensions: Provide insulation boards of not more than 24 by 48 inches (610 by 1219 mm), with thickness indicated on Drawings.
 3. Foam Buildouts: Provide with profiles and dimensions indicated on Drawings.
- E. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) according to ASTM E 2098/E 2098M and the following:
1. Reinforcing Mesh for EIFS, General: Not less than 11.2 oz./yd² (380 g/m²) or as otherwise required to comply with High Impact Classification.
 2. Strip-Reinforcing Mesh: Not less than 3.75 oz./yd². (127 g/m²).
 3. Detail-Reinforcing Mesh: Not less than 4.0 oz./yd². (136 g/m²).
 4. Corner-Reinforcing Mesh: Not less than 7.2 oz./yd². (244 g/m²).
- F. Base Coat: EIFS manufacturer's standard mixture complying with the following:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Sto Corp; Sto BTS Xtra or comparable product by one of the other specified manufacturers.
 2. Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
- G. Finish Coating System: EIFS manufacturer's standard acrylic-based coatings with enhanced mildew resistance complying with the following:
1. Basis-of-Design Products: Subject to compliance with requirements, provide the following products or comparable products by one of the other specified manufacturers.
 - a. Primer: Sto Corp; StoPrime.
 - b. Finish Coat: Sto Corp; Stolit 1.5.
 2. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, and fillers used with stone particles for embedding in finish coat to produce an applied-aggregate finish.

3. Color and Texture: Medium texture in color as selected by Architect from manufacturer's full range.
- H. Water: Potable.
- I. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784, manufacturer's standard cell class for use intended, and ASTM C 1063.
1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
 2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
 3. Weep Screed/Track: Prefabricated, one-piece type for attachment behind insulation with perforated face leg extended to form a drip and weep holes in track bottom, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.
 4. Expansion Joint: Closed-cell polyethylene backer rod and elastomeric sealant 3/4-inch- (19-mm-) minimum.
 5. Windowsill Flashing: Prefabricated type for both flashing and sloping sill over framing beneath windows; with end and back dams; designed to direct water to exterior.
 6. Parapet Cap Flashing: Type for both flashing and covering parapet top, with design complying with ASTM C 1397 and ANSI/SPRI/FM 4435/ES-1.

2.4 MIXING

- A. Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials, except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

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 roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Begin coating application only after surfaces are dry.

2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.
- C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.
 1. Concrete Substrates: Provide clean, dry, neutral-pH substrate for insulation installation. Verify suitability of substrate by performing bond and moisture tests recommended by EIFS manufacturer.

3.3 EIFS INSTALLATION, GENERAL

- A. Comply with ASTM C 1397, ASTM E 2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

3.4 SUBSTRATE PROTECTION APPLICATION

- A. Water-Resistive Barrier Coating: Apply over indicated substrate to provide a water-resistive barrier.
 1. Tape and seal joints, exposed edges, terminations, and inside and outside corners of sheathing unless otherwise indicated by EIFS manufacturer's written instructions.
- B. Flexible-Membrane Flashing: Install over water-resistive barrier coating, applied and lapped to shed water; seal at openings, penetrations, and terminations. Prime substrates with flashing primer if required and install flashing.

3.5 TRIM INSTALLATION

- A. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, at windowsills, and elsewhere as indicated. Coordinate with installation of insulation.
 1. Weep Screed/Track: Use at bottom termination edges, at window and door heads of water-drainage EIFS unless otherwise indicated.
 2. Windowsill Flashing: Use at windows unless otherwise indicated.
 3. Expansion Joint: Use where indicated on Drawings.
 4. Casing Bead: Use at other locations.
 5. Parapet Cap Flashing: Use where indicated on Drawings.

3.6 INSULATION INSTALLATION

- A. Board Insulation: Adhesively attach insulation to substrate in compliance with ASTM C 1397 and the following:
1. Apply adhesive to insulation by notched-trowel method, with notches oriented vertically to produce drainage channels that remain functional after the insulation is adhered to substrate.
 2. Press and slide insulation into place. Apply pressure over entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
 3. Allow adhered insulation to remain undisturbed for not less than 24 hours, before beginning rasping and sanding insulation or applying base coat and reinforcing mesh.
 4. Apply insulation over substrates in courses with long edges of boards oriented horizontally.
 5. Begin first course of insulation from screed/track and work upward. Work from perimeter casing beads toward interior of panels if possible.
 6. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints, so no piece of insulation is less than 12 inches (300 mm) wide or 6 inches (150 mm) high. Offset joints not less than 6 inches (150 mm) from corners of window and door openings and not less than 4 inches (100 mm) from aesthetic reveals.
 - a. Adhesive Attachment: Offset joints of insulation not less than 6 inches (150 mm) from horizontal and 4 inches (100 mm) from vertical joints in sheathing.
 7. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than 1/16 inch (1.6 mm) occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
 8. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
 9. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 inch (0.8 mm) from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 inch (1.6 mm). Prevent airborne dispersal and immediately collect insulation raspings or sandings.
 10. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than 3/4 inch (19 mm).
 11. Install foam buildouts and attach to structural substrate by adhesive.
 12. Interrupt insulation for expansion joints where indicated.
 13. Form joints for sealant application with back-to-back casing beads for joints within EIFS and with perimeter casing beads at dissimilar adjoining surfaces. Make gaps between casing beads and between perimeter casing beads and adjoining surfaces of width indicated.
 14. Before installing insulation and before applying field-applied reinforcing mesh, fully wrap board edges. Cover edges of board and extend encapsulating mesh not less than 2-1/2 inches (64 mm) over front and back face unless otherwise indicated on Drawings.
 15. Treat exposed edges of insulation as follows:
 - a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.

- b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
 - c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.
16. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-resistive barrier coating.
- B. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer, and as follows:
1. At expansion joints in substrates behind EIFS.
 2. Where EIFS adjoin dissimilar substrates, materials, and construction, including other EIFS.
 3. Where wall height or building shape changes.
 4. Where EIFS manufacturer requires joints in long continuous elevations.

3.7 BASE-COAT APPLICATION

- A. Base Coat: Apply full coverage to exposed insulation and foam build-outs with not less than 1/16-inch (1.6-mm) dry-coat thickness.
- B. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C 1397. Do not lap reinforcing mesh within 8 inches (200 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.
- C. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C 1397 in same manner as first application. Do not apply until first base coat has cured.
- D. Additional Reinforcing Mesh: Apply strip-reinforcing mesh around openings, extending 4 inches (100 mm) beyond perimeter. Apply additional 9-by-12-inch (230-by-300-mm) strip-reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- (200-mm-) wide, strip-reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches (100 mm) on each side of corners.
1. At aesthetic reveals, apply strip-reinforcing mesh not less than 8 inches (200 mm) wide.
 2. Embed strip-reinforcing mesh in base coat before applying first layer of reinforcing mesh.
- E. Foam Buildouts: Fully embed reinforcing mesh in base coat.

3.8 FINISH-COAT APPLICATION

- A. Primer: Apply over dry base coat.

- B. Finish Coat: Apply full-thickness coverage over dry primed base coat, maintaining a wet edge at all times for uniform appearance, to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

3.9 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Water-resistive barrier coatings applied over sheathing.
- B. EIFS will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

- A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.

END OF SECTION 07 24 19

SECTION 07 42 19 - INSULATED METAL WALL PANELS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Foamed-insulation-core metal wall panels.
- B. Related Requirements:
 - 1. Section 13 34 19 "Metal Building Systems" for steel framing, girts, and miscellaneous supports.

1.3 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 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.

1.4 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 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 (1:10).
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.
1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Benchmarks: Build benchmark to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 1. Build benchmark of typical wall metal panel assembly by installing at least 4 full height panels, including corner, supports, attachments, and accessories.
 2. Approval of benchmark does not constitute approval of deviations from the Contract Documents contained in benchmarks unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved benchmark may become part of the completed Work.

1.8 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.

1.9 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.

1.10 COORDINATION

- A. 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.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 72:
 1. Wind Loads: As indicated on Drawings.
 2. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Air Infiltration: Air leakage of not more than 0.01 cfm/sq. ft. (0.05 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:
 1. Test-Pressure Difference: 20 lbf/sq. ft. (958 Pa).
- C. Water Penetration under Static Pressure: No uncontrolled water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 1. Test-Pressure Difference: 20 lbf/sq. ft. (958 Pa).
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
 1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
 2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
 3. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
 4. Potential Heat: Acceptable level when tested according to NFPA 259.

5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
 1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
 - a. Closed-Cell Content: 95 percent when tested according to ASTM D 6226.
 - b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested according to ASTM D 1622.
 - c. Compressive Strength: Minimum 15 to 22 psi (105 to 154 kPa) when tested according to ASTM D 1621.
 - d. Shear Strength: Minimum 16 psi (110 kPa) in any direction when tested according to ASTM C 273/C 273M.
- B. Concealed Fastener, Foamed-Insulation-Core Metal Wall Panel: Structural metal panel consisting of flush, smooth exterior metal sheet, and interior metal sheet with planked profile, with factory foamed-in-place polyurethane core in thermally-separated profile, with tongue-and-groove panel edges, attached to supports using concealed fasteners.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide MBCI; a division of NCI Group, Inc.; CF Architectural Wall Panel or comparable product by one of the following:
 - a. CENTRIA Architectural Systems.
 - b. Kingspan Insulated Panels.
 - c. Metl-Span.
 2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Exterior Thickness: 0.034 inch (0.86 mm).
 - b. Exterior Finish: Three-coat fluoropolymer.
 - 1) Color: As selected by Architect from manufacturer's full range.
 - c. Nominal Interior Thickness: 0.028 inch (0.71 mm).
 - d. Interior Finish: Siliconized polyester.
 - 1) Color: As selected by Architect from manufacturer's full range.

3. Panel Coverage: 36 inches (914 mm) nominal.
4. Panel Thickness: 3.0 inches (76 mm).
5. Thermal Performance:
 - a. Thermal-Resistance Value (R-Value): 21.4 hr•ft²•°F/Btu according to ASTM C 518.
 - b. Thermal Transmittance Value (U-Value): 0.0527 Btu/hr•ft²•°F according to ASTM C 1363.

2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, 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 rakes, 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- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant 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 (13 mm) wide and 1/8 inch (3 mm) 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.

2.4 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: 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 wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 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 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. 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.

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 (0.013 mm).

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 wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
 2. Panel Support Tolerances: Confirm that metal panel supports are within tolerances acceptable to metal panel manufacturer but not greater than the following:
 - a. 1/4 inch (6 mm) in 20 foot (6100 mm) in any direction.
 - b. 3/8 inch (9 mm) over any single wall plane.
 - c. At Girt Spacing 10 feet (3048 mm) or more: 1/4 inch (6 mm) out only.
 - d. At Girt Spacing Less Than 10 feet (3048 mm): 1/8 inch (3 mm) out only.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.

4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. 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: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. 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 by metal panel manufacturer; or, if not indicated, provide 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 Section 07 92 00 "Joint Sealants."

3.4 INSULATED METAL WALL PANEL INSTALLATION

- A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
1. Fasten insulated metal wall panels to on exterior side of girt supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.
 - a. Install clips to supports with self-tapping fasteners.
 2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
 3. Provide metal-backed washers under heads of required exposed fasteners on weather side of insulated metal wall panels.
 - a. 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. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
 5. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.

- B. Installation Tolerances: Shim and align insulated metal wall panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), noncumulative; level, plumb, and on location lines; and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. 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 panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- D. 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 are permanently watertight.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform 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 test and inspect completed metal 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 panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 19

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SECTION 07 72 00 - ROOF ACCESSORIES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Roof hatches.
- B. Related Sections:
 - 1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
 - 2. Section 05 52 13 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
 - 3. Section 07 62 00 "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.
 - 4. Section 07 71 00 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.

1.3 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
 - 1. Include plans, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

1.5 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.
 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 4. Required clearances.
- B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS**2.1 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.

2.2 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company (The); Type E Roof Hatch or comparable product by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - d. Pate Company (The).
- B. Type and Size: Single-leaf lid, 36 by 36 inches (900 by 900 mm).
- C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.
- D. Hatch Material: Zinc-coated (galvanized) steel sheet.

1. Thickness: 0.079 inch (1.9 mm).
 2. Finish: Baked enamel or powder coat.
- E. Construction:
1. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 3. Insulation: Glass-fiber board; 1 inch (25 mm) thick.
 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
 6. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
 7. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Spring operators, hold-open arm, galvanized-steel spring latch with turn handles, galvanized-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company (The); Type RL2-E or comparable product by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - d. Pate Company (The).
 2. Height: 42 inches (1060 mm) above finished roof deck.
 3. Posts and Rails: Aluminum pipe, 1-1/4 inches (31 mm) in diameter, schedule 40.
 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
 5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
 7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
 8. Fabricate joints exposed to weather to be watertight.
 9. Fasteners: Manufacturer's standard, finished to match railing system.
 10. Finish: Manufacturer's standard.
 - a. Color: Yellow.

- H. 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 (The); Type UL-1 or comparable product by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
 - d. Pate Company (The).
 2. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
 3. Height: 42 inches (1060 mm) above finished roof deck.
 4. Post: High strength square tubing with a pull up loop installed at the upper end of the post.
 5. Material: Steel.
 6. Balancing spring: Stainless steel spring balancing mechanism for raising and lowering the safety post.
 7. Hardware: All mounting hardware shall be Type 316 stainless steel.
 8. Finish: Manufacturer's standard baked enamel or powder coat.
 - a. Color: Yellow.

2.3 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.
1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).
 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- C. Steel Tube: ASTM A 500/A 500M, round tube.
- D. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- E. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- F. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.4 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. Glass-Fiber Board Insulation: ASTM C 726, nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C), 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 (38 mm) thick.
- D. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- E. Elastomeric Sealant: ASTM C 920, elastomeric 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.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, 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.
- C. Roof-Hatch Installation:
1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 2. Attach safety railing system to roof-hatch curb.
 3. Attach ladder-assist post according to manufacturer's written instructions.
- D. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780/A 780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 00 "Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 92 00 - 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. Silicone joint sealants.
 - 2. Nonstaining silicone joint sealants.
 - 3. Urethane joint sealants.
 - 4. Mildew-resistant joint sealants.
 - 5. Polysulfide joint sealants.
 - 6. Latex joint sealants.
 - 7. Acoustical joint Sealants

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 - 1. Joint-sealant location and designation.
 - 2. Manufacturer and product name.
 - 3. Type of substrate material.
 - 4. Proposed test.
 - 5. Number of samples required.
- D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- E. 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.
- F. Field-Adhesion-Test Reports: For each sealant application tested.
- G. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- 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.

1.7 FIELD 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 (5 deg C).
 - 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: 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: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: 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 stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from 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 JOINT SEALANTS, 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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide elastomeric joint sealants that are water, ozone, chemical, and UV resistant and will not detrimentally affect joint substrates.
- C. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

2.3 SILICONE JOINT SEALANTS

- A. Silicone, Nonstaining, S, NS, 50, NT (JS-S1): Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 756 SMS.
 - b. Momentive Performance - Silicones; SilPruf NB SCS9000.
 - c. Pecora Corporation; 898NST.
 - d. Tremco Incorporated; Spectrem 2.
- B. Silicone, S, NS, 50, NT (JS-S2): Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; Dow Corning® 791 Silicone Weatherproofing Sealant.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS2000 SilPruf.
 - c. Pecora Corporation; PCS.
 - d. Tremco Incorporated; Spectrem 2.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT (JS-U1): Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation; Construction Systems; MasterSeal TX 1.
 - b. Pecora Corporation; Dynatrol I-XL.
 - c. Sika Corporation, Construction Products Division; Sikaflex - 1a.
 - d. Tremco Incorporated; Dymonic.
- B. Urethane, S, P, 25, T, NT (JS-U2): Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation; Construction Systems; MasterSeal SL 1.
 - b. Pecora Corporation; NR-201.
- C. Urethane, M, P, 25, T, NT (JS-U3): Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation; Construction Systems; MasterSeal SL 2.
 - b. LymTal International Inc; Iso-Flex 880 GB.
 - c. Pecora Corporation; Dynatrol II SG.
 - d. Sika Corporation; Joint Sealants; Sikaflex 2c SL.
 - e. Tremco Incorporated; THC 900/901.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT (JS-S3): Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; Dow Corning® 786 Silicone Sealant -.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
 - c. Tremco Incorporated; Tremsil 200.

2.6 LATEX JOINT SEALANTS

- A. Acrylic Latex (JS-L1): Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation; Construction Systems; Sonolac.
 - b. Pecora Corporation; AC-20.
 - c. Tremco Incorporated; Tremflex 834.

2.7 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant (JS-A1): 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. Available Products: Subject to compliance with requirements, provide one of the following:
 - a. Momentive Performance Materials; RCS 20.
 - b. Pecora Corporation; AC-20 FTR.
 - c. Tremco Incorporated; Tremco Acoustical Sealant.
 - d. USG Corporation; SHEETROCK Brand Acoustical Sealant.

2.8 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation; Construction Systems; MasterSeal 920 & 921.
 - b. Construction Foam Products; a division of Nomaco, Inc.; SOF Rod or HBR.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to exterior concrete and masonry substrates.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing 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.
 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.
- 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.

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 2000 feet (600 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces (JS-U1).
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces (JS-U2).
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in ceramic tile flooring.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, P, 25, T, NT.
- C. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces (JS-U3).
1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between different materials listed above.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, M, P, 25, T, NT.

- D. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces (JS-S1).
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Joints in dimension stone veneer.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - f. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
- E. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces (JS-S2).
1. Joint Locations:
 - a. Joints between metal panels.
 - b. Perimeter joints between metal panels and frames of doors, windows, and louvers.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, S, NS, 50, NT.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces (JS-S3).
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
- G. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement (JS-L1).
1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior standard steel doors and frames.
- B. Related Requirements:
 - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

- B. Shop Drawings: Include the following:
1. Elevations of each door type.
 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 7. Details of anchorages, joints, field splices, and connections.
 8. Details of accessories.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following members of the Steel Door Institute (SDI):
1. Amweld International, LLC.
 2. Ceco Door; ASSA ABLOY.
 3. Mesker Door Inc.
 4. Pioneer Industries.
 5. Republic Doors and Frames.
 6. Steelcraft; an Allegion brand.

- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than **0.40 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m)** when tested according to ASTM C 518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.
1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: **1-3/4 inches (44.5 mm)**.
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.042 inch (1.0 mm)**.
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Core: Vertical steel stiffener.
 - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated doors.
 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch (1.3 mm)**.
 - b. Construction: Full profile welded.
 3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.
1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: Vertical steel stiffener.
 - i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.
2. Frames:
- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
 - b. Construction: Full profile welded.
3. Exposed Finish: Prime.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) 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.

2.6 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- B. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- C. 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.
- D. 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.
- E. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

2.7 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum **3/4 inch (19 mm)** beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 2. 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.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 - 1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.

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. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than **9 inches (230 mm)** o.c. and not more than **2 inches (51 mm)** o.c. from each corner.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with SDI A250.11.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 2. Fire-Rated Openings: Install frames according to NFPA 80.

3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 CLEANING AND TOUCHUP

- A. 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.

END OF SECTION 08 11 13

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SECTION 08 31 13 - ACCESS DOORS AND FRAMES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Section 07 72 00 "Roof Accessories" for roof hatches.
 - 2. Section 23 85 00 "Ductwork and Accessories" for heating and air-conditioning duct access doors.
- C. Access doors and frames are part of an access door and frame allowance.

1.3 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. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.
- C. Product Schedule: For access doors and frames.

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 ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Karp Associates, Inc.
 - d. Nystrom, Inc.
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: 24 inches by 24 inches (600 mm by 600 mm) or as otherwise indicated on the Drawings are required for specific access.
5. Materials:
 - a. General Application: Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage factory primed.
 - b. Toilet Rooms and Food Preparation Areas: Stainless-Steel Sheet for Door: Nominal 0.062 inch (1.59 mm), 16 gage, No. 4 finish.
6. Frame Material: Same material and thickness as door.
7. Latch and Lock: Cam latch, screwdriver operated with interior release.

B. Recessed Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Karp Associates, Inc.
 - d. Nystrom, Inc.
2. Description: Door face recessed 5/8 inch (16 mm) for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Ceiling.
4. Door Size: 24 inches by 24 inches (600 mm by 600 mm).
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed.
6. Latch and Lock: Cam latch, screwdriver operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.

- c. Karp Associates, Inc.
 - d. Nystrom, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
 3. Locations: Ceiling.
 4. Door Size: 24 inches by 24 inches (600 mm by 600 mm).
 5. Fire-Resistance Rating: Not less than that of adjacent construction.
 6. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gage, factory primed.
 7. Frame Material: Same material, thickness, and finish as door.
 8. Latch and Lock: Self-closing, self-latching door hardware, operated by key.

2.4 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 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. Latch and Lock Hardware: Furnish number of latches and locks required to hold doors tightly closed. Furnish two keys per lock and key all locks alike.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- E. Stainless-Steel Finishes:
 - 1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
 - 2. Polished Finish: No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - a. Run grain of directional finishes with long dimension of each piece.
 - b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

SECTION 08 36 13 - SECTIONAL DOORS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electrically operated insulated sectional doors.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of sectional door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied finishes.
 - 1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
 - 1. Flat door sections with sensor edge on bottom section.
 - 2. Frame for paneled door sections; of each width of stile and rail required.
 - 3. Panel for raised-panel door sections; not smaller than required to show raised-panel profile.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sectional doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors 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. Failure of components or operators before reaching required number of operation cycles.
 - c. Faulty operation of hardware.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
 - e. Delamination of exterior or interior facing materials.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS, GENERAL**

- A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
 - 1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.
- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
 - 1. Design Wind Load: As indicated on Drawings.
 - 2. Testing: According to ASTM E 330 or DASMA 108 for garage doors and complying with the acceptance criteria of DASMA 108.
 - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
 - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
 - b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.
 - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

- A. Steel Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation "Insulated Model 470" or comparable product by one of the following:
 - a. Amarr Garage Doors.
 - b. Clopay Building Products.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
- C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283 or DASMA 105.
- D. Installed R-Value: 9.83 deg F x h x sq. ft./Btu (1.73 K x sq. m/W).
- E. Steel Sections: Zinc-coated (galvanized) steel sheet with G90 (Z275) zinc coating.
 - 1. Section Thickness: 2 inches (51 mm).
 - 2. Exterior-Face, Steel Sheet Thickness: 0.022-inch- (0.56-mm-) nominal coated thickness.
 - a. Surface: Manufacturer's standard, ribbed.
 - 3. Insulation: Foamed in place.
 - 4. Interior Facing Material: Zinc-coated (galvanized) steel sheet with a nominal coated thickness of 0.017 inch (0.10 mm).

- F. Track Configuration: Vertical-lift track.
- G. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.
- H. Counterbalance Type: Torsion spring.
- I. Electric Door Operator: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
 - 1. Usage Classification: Light duty, up to 10 cycles per hour.
 - 2. Motor Exposure: Interior, clean, and dry.
 - 3. Emergency Manual Operation: Push-up type.
 - 4. Obstruction-Detection Device: Pneumatic sensor.
 - a. Sensor Edge Bulb Color: Black.
 - 5. Control Station: Interior-side mounted.
- J. Door Finish:
 - 1. Factory Finish: As selected by Architect from manufacturer's standard colors.
 - 2. Finish of Interior Facing Material: Match finish of exterior section face.

2.4 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 STEEL DOOR SECTIONS

- A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated zinc coating and thickness.
 - 1. Fabricate section faces from single sheets to provide sections not more than 24 inches (610 mm) high and of indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
 - 2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.
- B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch- (1.63-mm-) nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than 0.064-inch- (1.63-mm-) thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches (1219 mm) apart.

- C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile.
- D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.
- E. Provide reinforcement for hardware attachment.
- F. Board Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polystyrene or polyurethane board insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84; or with glass-fiber-board insulation. Secure insulation to exterior face sheet. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.
- G. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653/A 653M, with indicated thickness.
- H. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

- A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.
 - 1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 (Z180) zinc coating.
 - 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.
 - 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.
 - a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
- B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.7 HARDWARE

- A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.
- B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- (2.01-mm-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's

written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet (4.88 m) wide unless otherwise recommended by door manufacturer.

- C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- (76-mm-) diameter roller tires for 3-inch- (76-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.

2.8 COUNTERBALANCE MECHANISM

- A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.
- B. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.
- C. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 feet (4.88 m) long unless closer spacing is recommended by door manufacturer.
- D. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 7 to 1.
- E. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.
- F. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
- G. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Operation: Lift handles and pull rope for raising and lowering doors, with counterbalance mechanism designed so that required lift or pull for door operation does not exceed 25 lbf (111 N).

2.10 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Manufacturer: Subject to compliance with requirements, provide product by the following:
 - a. Chamberlain Group, Inc. (The).
 2. Comply with NFPA 70.
 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
 5. Use adjustable motor-mounting bases for belt-driven operators.
- E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
1. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."
 - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Tracks:
 - 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm) apart.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICES

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 08 36 13

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SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Storefront framing.
 - 2. Manual-swing entrance doors.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
 - 4. Include point-to-point wiring diagrams showing the following:
 - a. Power requirements for each electrically operated door hardware.

- b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
- C. Samples for 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.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Preconstruction Laboratory Mockup Testing Submittals:
 - 1. Testing Program: Developed specifically for Project.
 - 2. Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
 - 3. Record Drawings: As-built drawings of preconstruction laboratory mockups showing changes made during preconstruction laboratory mockup testing.
- B. Qualification Data: For Installer and field testing agency.
- C. 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.
- D. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Source quality-control reports.
- F. Field quality-control reports.

- G. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Structural failures, including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "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, 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.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), 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 (3.2 mm).
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
- E. Structural: Test according to ASTM E 330/E 330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
 2. Entrance Doors:
 - a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- 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, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.38 Btu/sq. ft. x h x deg F (2.15 W/sq. m x K) as determined according to NFRC 100.
 2. Thermal Transmittance (U-factor): Operable units shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
 3. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have SHGC of no greater than 0.40 as determined according to NFRC 200.
 4. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.3 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. EFCO Corporation.
 2. Kawneer North America; an Alcoa company.

3. Manko Window Systems, Inc.
 4. Oldcastle BuildingEnvelope™.
 5. YKK AP America Inc.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.4 FRAMING COMPONENTS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Frame Depth: Not less than 4-1/2 inches (114 mm).
 4. Face Width: Not less than 2 inches (51 mm).
 5. Glazing Plane: Center.
 6. Finish: Clear anodic finish.
 7. Fabrication Method: Field-fabricated stick system.
 8. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 9. Steel Reinforcement: As required by manufacturer.
- 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.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
1. Door Construction: 2- to 2-1/4-inch (50.8- to 57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

2.7 GLAZING

- A. Glazing: Comply with Section 08 80 00 "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.

2.8 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 3. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 4. Structural Profiles: ASTM B 308/B 308M.
- B. Steel Reinforcement:
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
 4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.9 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. Use exposed fasteners with countersunk Phillips screw heads, fabricated from 300 series stainless steel.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) 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. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- E. Rigid PVC Filler.

2.10 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 exterior.
 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 screw-spline system.
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 1. At exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 1. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.11 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.12 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

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 structural 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.
- 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 07 92 00 "Joint Sealants," to produce weathertight installation.

- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing as specified in Section 08 80 00 "Glazing."
- F. Install weatherseal sealant according to Section 07 92 00 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

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 (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
 - 4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) 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 a minimum of three tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - a. Perform a minimum of three tests in areas as directed by Architect.
 - b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 MAINTENANCE SERVICE

- A. Entrance Door Hardware:
 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 08 41 13

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SECTION 08 71 20 – DOOR HARDWARE - MULTIPURPOSE BUILDING

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 commercial door hardware for the following:
1. Swinging doors.
 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
 2. Electromechanical door hardware.
 3. Cylinders specified for doors in other sections.
- C. Related Sections:
1. Section 08 11 13 “Hollow Metal Doors and Frames”.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. ICC/IBC - International Building Code.
 3. NFPA 70 - National Electrical Code.
 4. NFPA 80 - Fire Doors and Windows.
 5. NFPA 101 - Life Safety Code.
 6. NFPA 105 - Installation of Smoke Door Assemblies.
 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
1. ANSI/BHMA Certified Product Standards - A156 Series
 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Section 01 77 00 "Closeout Procedures."

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- F. Keying Conference: Conduct conference to comply with requirements in Section 01 31 00 "Project Management and Coordination." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
 2. Plans for existing and future key system expansion.
 3. Requirements for key control storage and software.
 4. Installation of permanent keys, cylinder cores and software.
 5. Address and requirements for delivery of keys.
- G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Section 01 31 00 "Project Management and Coordination" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to

source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Special Warranty Periods:
1. Ten years for mortise locks and latches.
 2. Twenty five years for manual surface door closer bodies.
 3. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Acceptable Manufacturers:
 - a. Bommer Industries (BO).
 - b. Hager Companies (HA).
 - c. McKinney Products (MK).

2.3 POWER TRANSFER DEVICES

- A. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
 - 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney Products (MK) - Connector Hand Tool: QC-R003.
 - 2. Acceptable Manufacturers:
 - a. McKinney Products (MK) – QC-C Series.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 2. Furnish dust proof strikes for bottom bolts.
 3. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 4. Acceptable Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).
- B. Coordinators: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
1. Acceptable Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).

2.5 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
1. Acceptable Manufacturers:
 - a. Stanley Best (BE).
 - b. No Substitution.
- B. Cylinders: Original manufacturer cylinders complying with the following:
1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
 4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. New System: Key locks to a *new or existing key system* as directed by the Owner.

- D. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).
- E. Construction Keying: Provide construction master keyed cylinders.
- F. Key Registration List (Bitting List):
1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 2. Provide transcript list in writing or electronic file as directed by the Owner.
- G. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
1. Acceptable Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – ML2000 Series.
 - b. Sargent Manufacturing (SA) – 8200 Series.
 - c. Stanley Best (BE) – 40H Series.

2.7 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 ELECTRIC STRIKES

- A. Standard Electric Strikes: Heavy duty, cylindrical and mortise lock electric strikes conforming to ANSI/BHMA A156.31, Grade 1, UL listed for both Burglary Resistance and for use on fire rated door assemblies. Stainless steel construction with dual interlocking plunger design tested to exceed 3000 lbs. of static strength and 350 ft-lbs. of dynamic strength. Strikes tested for a minimum 1 million operating cycles. Provide strikes with 12 or 24 VDC capability and supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.
 1. Acceptable Manufacturers:
 - a. Folger Adam EDC (FO).
 - b. HES (HS).

2.9 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – DC6000 Series.
 - b. Sargent Manufacturing (SA) - 351 Series.
 - c. Norton Door Controls (NO) - 7500 Series.
 - d. Yale Locks and Hardware (YA) - 4400 Series.
- C. Door Closers, Surface Mounted (Unitrol): Unitrol arms to have door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.
1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - Unitrol Series.
 - b. Norton Door Controls (NO) - Unitrol Series.
 - c. Yale Locks and Hardware (YA) - Unitrol Series.

2.10 ARCHITECTURAL TRIM

- A. Door Protective Trim
1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW). Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
 4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
 6. Acceptable Manufacturers:
 - a. Burns Manufacturing (BU).

- b. Rockwood Manufacturing (RO).
- c. Trimco (TC).

2.11 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Acceptable Manufacturers:
 - a. Burns Manufacturing (BU).
 - b. Rockwood Manufacturing (RO).
 - c. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Acceptable Manufacturers:
 - a. Rixson Door Controls (RF).
 - b. Rockwood Manufacturing (RO).
 - c. Sargent Manufacturing (SA).

2.12 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- E. Acceptable Manufacturers:
 1. National Guard Products (NG).
 2. Pemko Manufacturing (PE).
 3. Reese Enterprises, Inc. (RE).

2.13 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 1. Acceptable Manufacturers:
 - a. Securitron (SU) - DPS Series.
- B. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 1. Acceptable Manufacturers:
 - a. Securitron (SU) - BPS Series.

2.14 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09

Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07 92 00 "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

Hardware Sets

Set: 1.0

Doors: 101

2 Continuous Hinge	CFMHD1 PT	PE	087100	
1 Removable Mullion	L980A	US28	SA	087100
1 Rim Exit Device	LC 55 56 8804 862	US32D	SA	087100 ⚡
1 Rim Exit Device	55 56 8810 862	US32D	SA	087100 ⚡
2 Mortise Cylinder	1E-74	626	BE	087100

USD 320 WAMEGO SCHOOL DISTRICT IMPROVEMENTS

BBN ARCHITECTS INC.

AUGUST 31, 2017

2 Door Closer	CPS7500	689	NO 087100	
2 Bracket	6890	689	NO 087100	
2 Blade Stop	6891	689	NO 087100	
1 Threshold	273x3AFG		PE 087100	
1 Set Weatherstrip	by Door Manufacturer			
2 Sweep	by Door Manufacturer			
1 Astragal Set	by Door Manufacturer			
2 ElectroLynx Harness	QC-C1500P		MK 087100	↔
2 ElectroLynx Harness	QC-CxxP (size to door width/hardware)		MK 087100	↔
2 Electric Power Transfer	EL-CEPT		SU 087100	↔
2 Position Switch	DPS		SU 087100	↔
1 Power Supply	per the requirements of the hardware components		SU 087100	↔
1 CARD READER	Wall Reader to be provided by Systems Integrator			

Notes: OPENING CAN BE ACCESSED VIA VALID CREDENTIAL OR MECHANICAL KEY. ALWAYS FREE EGRESS. CONTRACTOR TO PROVIDE WIRING DIAGRAMS FOR OPENING. ALUMINUM DOOR PROVIDER WILL NEED TO COORDINATE SPECIFIED HARDWARE WITH THE STILE AND RAILS OF THE ALUMINUM DOOR TO ENSURE ADEQUATE SPACE TO INSTALL HARDWARE WITHOUT MODIFICATION TO HARDWARE OR USE OF A DROP PLATE.

Set: 2.0

Doors: 105a, 109b

1 Continuous Hinge	CFMHD1		PE 087100	
1 Office Lock	45H7A 15H	630	BE 087100	
1 Mortise Cylinder	1E-74	626	BE 087100	
1 Door Closer	CPS7500	689	NO 087100	
1 Threshold	273x3AFG		PE 087100	
1 Gasketing	2891AS		PE 087100	
1 Rain Guard	346C		PE 087100	
1 Sweep	3452AV		PE 087100	

Set: 3.0

Doors: 105b, 109c

1 Cylinder Rim/Mortise	as Required	626/630	BE	
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Set: 4.0

Doors: 109a

2 Continuous Hinge	CFMHD1		PE	087100
1 Concealed Vert Rod Exit	LC AD8613 ETL	US32D	SA	087100
1 Concealed Vert Rod Exit	AD8610 ETL	US32D	SA	087100
1 Mortise Cylinder	1E-74	626	BE	087100
1 Door Closer	7500	689	NO	087100
1 Door Closer	CPS7500	689	NO	087100
2 Bracket	6890	689	NO	087100
2 Blade Stop	6891	689	NO	087100
1 Wall Stop	409	US32D	RO	087100
1 Gasketing	Gasketing by Frame Manufacturer			
2 Sweep	by Door Manufacturer			
1 Astragal Set	by Door Manufacturer			

Notes: ALUMINUM DOOR PROVIDER WILL NEED TO COORDINATE SPECIFIED HARDWARE WITH THE STILE AND RAILS OF THE ALUMINUM DOOR TO ENSURE ADEQUATE SPACE TO INSTALL HARDWARE WITHOUT MODIFICATION TO HARDWARE OR USE OF A DROP PLATE.

Set: 5.0

Doors: 108

6 Hinge (heavy weight)	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1 Dust Proof Strike	570	US26D	RO	087100
2 Flush Bolt - HM	555	US26D	RO	087100
1 Storeroom Lock	45H7D 15H	626	BE	087100
1 Mortise Cylinder	1E-74	626	BE	087100
2 Door Closer	CPS7500T	689	NO	087100
1 Gasketing	S88D		PE	087100

Set: 6.0

Doors: 104, 107

3 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1 Office Lock	45H7A 15H	626	BE	087100
1 Mortise Cylinder	1E-74	626	BE	087100
1 Wall Stop	409	US32D	RO	087100
1 Gasketing	S88D		PE	087100

Set: 7.0

Doors: 106

3 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK 087100
1 Storeroom Lock	45H7D 15H	626	BE 087100
1 Mortise Cylinder	1E-74	626	BE 087100
1 Door Closer	7500ST	689	NO 087100
1 Gasketing	S88D		PE 087100

Set: 8.0

Doors: 102, 103

3 Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK 087100
1 Privacy Set	45H0L 15H VIN	630	BE 087100
1 Door Closer	7500	689	NO 087100
1 Wall Stop	409	US32D	RO 087100
1 Gasketing	S88D		PE 087100

Set: 9.0 (If Required)

Doors: MISC

1 BITTING LIST	KEY RECORDS	SA
1 Key Cabinet	Sized per specification documents	LU

END OF SECTION 08 71 20

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SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
1. Glass for windows, doors, interior borrowed lites, and storefront framing.
 2. Field-applied privacy film.
 3. Glazing sealants and accessories.
- B. Related Requirements:
1. Section 10 28 00 "Toilet and Bath Accessories" for framed mirrors.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.
 - 1. Coated glass.
 - 2. Insulating glass.
 - 3. Glass film.
- 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.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturers of insulating-glass units with sputter-coated, low-E coatings.
- B. Product Certificates: For glass.
- C. Product Test Reports: For coated glass insulating glass, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For 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 and certified 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. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating 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 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AGC Glass Company North America, Inc.
 - 2. Cardinal Glass Industries.
 - 3. Guardian Glass; SunGuard.
 - 4. Oldcastle BuildingEnvelope™.

5. [Pilkington North America.](#)
 6. [Vetrotech Saint-Gobain.](#)
 7. [Viracon, Inc.](#)
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
 2. 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 (25 mm)**, whichever is less.
 3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 2. For 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 (W/sq. m x K)**.
 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, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or 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.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. 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. Flatness Tolerances: Overall bow and warp shall not exceed 50 percent of values tabulated in ASTM C 1048.
 2. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated. Direction of roller wave shall be consistent throughout building.
 - a. Roller wave peak-to-valley deviation shall not exceed 0.003 inch (0.076 mm) "Peak to Valley" in the central area and 0.008 inch (0.2 mm) within 10-1/2 inches (267 mm) of the leading and trailing edge.
 - b. Tempered architectural safety glass shall conform to ANSI Z97.1 and CPSC 16 CFR 1201.
 - c. Provide heat soak testing conforming to EN14179 which includes a 2-hour dwell at 550°F ± 18°F (290°C ± 10°C).
- B. 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.
- C. Sputter-Coated Float Glass: Float glass with metallic-oxide or metallic-nitride coating deposited by vacuum deposition process after manufacture and heat treatment.

2.5 GLASS FILM

- A. Decorative Film Overlay: Translucent, dimensionally stable, cast PVC film, **2-mil- (0.05-mm-)** minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Window Film
 - b. [Avery Dennison Graphics](#)
 - c. Decorative Films, LLC.
 - d. digitalFX by Reid Witlin.
 - e. [FDC Graphic Films, Inc.](#)
 - f. Llumar Decorative Films.
 - g. Madico Films.
- B. Materials: Flexible polyester materials with scratch resistant coatings.
- C. Performance Requirements:
1. Scratch Resistance: Decorative films shall average less than 12 percent increase in haze when tested according to ASTM D1044 using a Teledyne Taber Abrader using CS10F Type III wheels each loaded to 0.5 kg for 100 cycles in a 70 percent vacuum.
 - a. Scratch resistance testing shall be performed by an independent third party agency.
 2. Surface Burning Characteristics: Provide films that have Flame Spread Index of 0 and Smoke Developed Index of 30 or less when tested in accordance with ASTM E84.
- D. Decorative Film Accessories: General: Provide accessories either manufactured by or acceptable to Decorative film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
1. Pressure sensitive adhesive: This adhesive is activated by pressure and water. It is characterized by its permanently tacky nature and its installation ease..
 2. Cleaners, Primers, and Sealers: Types recommended by film manufacturer.

2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.

2. Perimeter Spacer: Thermally broken aluminum with black, color anodic finish.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Technoform Glass Insulation NA, Inc.
 - 2) Thermix; a brand of Ensinger USA.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. 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 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Corning Corporation.
 - b. GE Construction Sealants; Momentive Performance Materials Inc.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM 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.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for

application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: 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).

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 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 (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 FILM INSTALLATION

- A. Preparation:
 - 1. Clean surfaces thoroughly prior to installation.
 - 2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. General: Install in accordance with manufacturer's instructions.
 - 1. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant.
 - 2. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
 - 3. Apply film to glass and lightly spray film with slip solution.
 - 4. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
 - 5. Remove air bubbles, blisters, and other defects.
 - 6. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
- C. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying with graphic image as indicated on Drawings to the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

3.8 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry

surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.9 MONOLITHIC INTERIOR GLASS SCHEDULE

- A. Glass Type 3: Clear heat-strengthened float glass.
1. Minimum Thickness: 6 mm.
- B. Glass Type 4: Clear fully tempered float glass.
1. Minimum Thickness: 6 mm.
 2. Safety glazing required.
- C. Heat Treated Monolithic-Glass: Provide clear heat-strengthened float glass or fully tempered float glass where full tempering is required to resist thermal stresses induced by differential

3.10 MONOLITHIC INTERIOR FILM OVERLAY GLASS SCHEDULE

- A. Glass Type GL-5: Glass with decorative film overlay.
1. Glass Type: Clear, heat-strengthened or fully tempered float glass.
 2. Glass Thickness: 6.0 mm.
 3. Use: Suitable for interior applications.
 4. Pattern: As selected by Architect from manufacturer's full range.

3.11 INSULATING GLASS SCHEDULE

- A. Glass Type 1 (Item 8.6): Low-E Coated Clear Insulating Glass with Fully Tempered Lites:
1. Basis-of-Design Product: Viracon, Solarscreen 2000 VE 1-2M.
 2. Overall Unit Thickness: 1 inch (25 mm).
 3. Minimum Thickness of Each Glass Lite: 6 mm.
 4. Indoor Lite: Fully tempered float glass.
 5. Interspace Content: Argon.
 6. Outdoor Lite: Fully tempered float glass.
 7. Low-E Coating: Sputtered on second surface.
 8. Winter Nighttime U-Factor: 0.25 maximum.
 9. Summer Daytime U-Factor: 0.21 maximum.

10. Visible Light Transmittance: 70 percent minimum.
11. Solar Heat Gain Coefficient: 0.37 maximum.
12. Shading coefficient: 0.43.
13. Relative heat gain: 89 BTU per hour per square foot.
14. Light to solar gain ratio (LSG): 1.9.
15. Safety glazing required for indoor lite.
16. Sealing system: Dual seal, with manufacturer's standard primary and secondary seals
17. Spacer: Thermoset structural silicone foam
18. Desiccant: Molecular sieve or silica gel, or blend of both.
19. IGCC certification: Level CBA.
20. Provide insulating glass units permanently marked either on spacers or on at least one component lite of units with certification label of IGCC.

B. Glass Type 2 (Item 8.xx6): Low-E Coated Clear Insulating Glass with Heat Strengthened Lites:

1. Basis-of-Design Product: Viracon, Solarscreen 2000 VE 1-2M.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Indoor Lite: Heat strengthened float glass.
5. Interspace Content: Argon.
6. Outdoor Lite: Heat strengthened float glass.
7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.25 maximum.
9. Summer Daytime U-Factor: 0.21 maximum.
10. Visible Light Transmittance: 70 percent minimum.
11. Solar Heat Gain Coefficient: 0.37 maximum.
12. Shading coefficient: 0.43.
13. Relative heat gain: 89 BTU per hour per square foot.
14. Light to solar gain ratio (LSG): 1.9.
15. Safety glazing required for indoor lite.
16. Sealing system: Dual seal, with manufacturer's standard primary and secondary seals
17. Spacer: Thermoset structural silicone foam
18. Desiccant: Molecular sieve or silica gel, or blend of both.
19. IGCC certification: Level CBA.
20. Provide insulating glass units permanently marked either on spacers or on at least one component lite of units with certification label of IGCC.

END OF SECTION 08 80 00

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SECTION 08 83 00 - MIRRORS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
 - 1. Plywood backed tempered glass mirrors qualifying as safety glazing.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for plywood backing panels.
 - 2. Section 08 80 00 "Glazing" for glass used for vision.
 - 3. Section 10 28 00 "Toilet and Bath Accessories" for metal-framed mirrors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, plywood backing, edge details, mirror hardware, and attachment details.
- C. Samples: For each type of the following:
 - 1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
1. Warranty Period: Five 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. D & W Incorporated.
 2. Gardner Glass, Inc.
 3. Glasswerks LA, Inc.
 4. Lenoir Mirror Company.
 5. Manko Window Systems, Inc.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.
 - 1. Nominal Thickness: 6.0 minimum.
- C. Safety Glazing Products: For tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

2.4 MIRROR HARDWARE

- A. "Z" Clip: Aluminum extrusions.
- B. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
 - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Andscot Company, Inc.
 - 2) Laurence, C. R. Co., Inc.
 - 3) Stylmark, Inc.
 - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Andscot Company, Inc.
 - 2) Laurence, C. R. Co., Inc.
 - 3) Stylmark, Inc.

3. Finish: Clear bright anodized.
- C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- D. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

- A. Fabricate mirrors in the shop to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished.
 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
- D. Plywood Backing: Adhere mirrors to 1/2 inch (12.7 mm) plywood backing panels as recommended by mirror manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

- B. Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.

3.3 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 08 83 00

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Gypsum Board Systems:
 - 1. Interior walls, partitions, and ceilings for tape and joint compound finish.
 - 2. Steel framing systems to receive gypsum board.
 - 3. Sound reduction membrane in gypsum drywall systems.
 - 4. Suspension systems for interior ceilings.

1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 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."

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
- B. Qualification Data: For finisher.

1.6 QUALITY ASSURANCE

- A. Finisher Qualifications: Minimum three years' experience in executing Level 5 finish in accordance with GA-214.
- B. Mockups for the following:

1. Levels of gypsum board finish for use in exposed locations.

1.7 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.

1.8 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. Performance: Fire and structural meeting requirements of building code and local authorities.
- B. 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.
- C. 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.
- D. Horizontal Deflection: For wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; ProRoc Type X.
 - b. Georgia-Pacific Building Products; "DensArmor Plus Fireguard."

- c. National Gypsum Company; Gold Bond Brand Fire-Shield Wallboard.
 - d. United States Gypsum Company; USG Sheetrock® Brand Firecode® X Gypsum Panels.
 2. Thickness: 5/8 inch (15.9 mm).
 3. Long Edges: Tapered.
- B. Mold and Mildew Resistant Gypsum Board: ASTM C 1396/C 1396M with moisture- and mold-resistant core and surfaces.
 1. Product: Subject to compliance with requirements, provide one of the following or an approved equal:
 - a. CertainTeed Corporation, M2Tech Moisture & Mold Resistant, Type X.
 - b. Georgia-Pacific Gypsum LLC, "DensArmor Plus, Fireguard Panels.
 - c. National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board.
 - d. USG Corporation, Sheetrock Brand Mold Tough AR Firecode (Type X).
 2. Core: 5/8 inch (15.9 mm), Type X.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
 5. Location: Above first course of dry interior gypsum board corridor partitions and all partitions in general use areas.
- C. Impact-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; Extreme Impact Resistant Gypsum Board with M2Tech.
 - b. Georgia-Pacific Building Products; DensArmor Plus Fireguard Impact-Resistant Interior Panel.
 - c. National Gypsum Company; Hi-Impact Brand XP Fire-Shield Wallboard.
 - d. USG Corporation; USG Sheetrock® Brand Mold Tough® VHI (Very High Impact) Firecode® Core.
 2. Core: 5/8 inch (15.9 mm), Type X.
 3. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
 4. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 1 requirements.
 5. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements.
 6. Hard-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
 7. Long Edges: Tapered.
 8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; ProRoc Interior Ceiling.

- b. Georgia-Pacific Building Products; DensArmor Plus High-Performance Interior Panel, Type C.
 - c. National Gypsum Company; High Strength Brand Ceiling Board.
 - d. United States Gypsum Company; Sheetrock Gypsum Panels.
2. Thickness: 1/2 inch (12.7 mm).
 3. Long Edges: Tapered.

2.3 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 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
 1. Steel Studs and Runners:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) CEMCO; California Expanded Metal Products Co.
 - 2) MBA Building Supplies.
 - 3) Steel Network, Inc. (The).
 - b. Minimum Base-Metal Thickness: 0.0329 inch (0.836 mm).
 - c. Depth: As indicated on Drawings.
- C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. ClarkDietrich Building Systems.
 - c. Steel Network, Inc. (The).
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ClarkDietrich Building Systems.
- E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ClarkDietrich Building Systems.
 2. Depth: 1-1/2 inches (38 mm).
 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ClarkDietrich Building Systems.
 2. Minimum Base-Metal Thickness: 0.0329 inch (0.836 mm).
 3. Depth: As indicated on the Drawings.
- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ClarkDietrich Building Systems.
- H. Column and Beam Drywall Clips: Clips for attachment to flanges of beams and columns for installation of gypsum board panels to provide fireproofing; galvanized steel.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Grabber Construction Products.
 2. Minimum Base-Metal Thickness: 0.025 inch (0.63 mm).
 3. Depth: 2 inches (51 mm).
 4. Width: 2-3/8 inches (60 mm)
 5. Height: 2 inches (51 mm)

2.4 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 2 inches (51 mm).
- D. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0329 inch (0.836 mm).
 - b. Depth: 2-1/2 inches (64 mm).
- E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Chicago Metallic Corporation.
 - c. United States Gypsum Company.

2.5 TRIM ACCESSORIES

- A. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Basis-of-Design Products: Subject to compliance with requirements, provide specified Fry Reglet Corporation products or comparable products by one of the following:
 - a. Gordon, Inc.
 - b. Pittcon Industries.
 2. Shapes:
 - a. Cornerbead: Corner Trim.
 - b. Reveal: "F" Reveal.
 - c. Molding: "J" Molding
 - d. Control Joint: 2-piece Drywall Control Joint.
 3. Dimensions: As indicated on the Drawings.
 4. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
 5. Finish: Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.6 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475/C 475M and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.

- B. Joint Tape for Gypsum Board: Pressure-sensitive or staple-attached, open-weave, glass-fiber reinforcing tape with setting-type joint compound.
- C. Setting-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.
 - 1. Ready-Mixed Formulation: Factory-mixed product.
 - a. Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
 - b. Topping compound formulated for fill (second) and finish (third) coats.
 - c. All-purpose compound formulated for both taping and topping compounds.

2.7 ACOUSTICAL MATERIALS

- A. Sound Attenuation Blankets: 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.
- B. Sound Reduction Membrane: Flexible acoustical recycled grade polymer sheet sound barrier.
 - 1. Basis-of-Design Products: Subject to compliance with requirements, provide Imetco WaveBlok SW or comparable products by another manufacturer.
 - a. Thickness: 1/8 inch (3 mm).
 - b. Weight: 1 lb/sq. ft. (4.88 kg/sq. m).
 - 2. Product Performance:
 - a. Sound Transmission: Minimum STC of 53 over steel framing.
 - b. Fire Rating: Class 1 according to ASTM E84 when installed behind specified gypsum board.
 - c. Mold and Mildew Resistance: No visible growth according to ASTM D 3273 and ASTM G21.
- C. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- D. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - c. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.8 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to steel framing.
- 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 (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
 - 3. For fastening sound reduction membrane, use flat-head or truss-head screws in sizes recommended by mesh manufacturer.
- D. Isolation Strip at Exterior Walls: Provide the following:
 - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.
- E. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until 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.

3.3 FRAMING INSTALLATION, GENERAL

- A. General: Comply with ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

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. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
 1. Where building structure abuts ceiling perimeter or penetrates ceiling.
 2. Where partition framing and wall furring abut structure, except at floor.
 - a. Provide slip- or cushioned-type joints as detailed to attain lateral support and avoid axial loading.
 - b. Install deflection track top runner to attain lateral support and avoid axial loading.
 - c. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.
 - 1) Attach jamb studs at openings to tracks using manufacturer's standard stud clip.
- F. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Suspend ceiling hangers from building 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 structural or ceiling suspension system. 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 the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Secure flat, angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or otherwise fail.

5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Sway-brace suspended steel framing with hangers used for support.
- C. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.
 1. Wire Hangers: 48 inches (1219 mm) o.c.
 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
 3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) as measured both lengthwise on each member and transversely between parallel members.

3.5 INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
 1. Where studs are installed directly against exterior walls, install foam gaskets.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
- D. Install steel studs and furring in sizes and at spacings indicated.
 1. Single-Layer Construction: Space studs 16 inches (406 mm) o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 1. Install 2 studs at each jamb, unless otherwise indicated.
 2. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

- G. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

3.6 INSTALLING SOUND REDUCTION MEMBRANE

- A. Sound Reduction Membrane: Install on face of steel studs and on bottom chord of wood trusses in areas indicated on the Drawings and in accordance with manufacturer's recommendations and the following:
 - 1. Install membrane to the face of steel studs at no less than 12 inches (300 mm) on center vertically. Stagger or butt edges of membrane on face of steel studs.
 - 2. Install membrane vertically on steel studs.
 - 3. Seal seams with manufacturers recommended sealing tape.

3.7 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board: Comply with ASTM C 840 and GA-216.
- B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- E. 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. Avoid joints other than control joints at corners of framed openings where possible.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
 - 1. Except where 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. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4 to 9.5-mm) wide joints to install sealant.
- J. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4 to 1/2-inch (6.4 to 12.7-mm) wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
 1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.8 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:
 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels horizontally (perpendicular 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 board.
 - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-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.

3.9 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install where indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.10 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
 - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 - 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
 - 3. Install U-bead where indicated.
- D. Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect; except, that in no case shall control joints in ceilings, soffits, or partitions be spaced at distance greater than 30" - 0" (9 m).
- E. Aluminum Trim: Install in locations indicated on Drawings.

3.11 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.
- D. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.
- E. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
 - 1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.

3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
4. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface of the following:
 - a. Partitions with continuous, unbroken length of 20 feet.
 - b. Horizontal and vertical surfaces of soffits.

3.12 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 09 21 16

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
 - 1. Acoustical Panels: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension-system members.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
 - 5. Size and location of initial access modules for acoustical panels.
 - 6. Items penetrating finished ceiling and ceiling-mounted items including the following:

- a. Lighting fixtures.
 - b. Diffusers.
 - c. Grilles.
 - d. Speakers.
 - e. Sprinklers.
 - f. Access panels.
 - g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
 8. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).
- B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 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: Class A according to ASTM E 1264.
 2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS (ACP-1)

- A. Basis-of-Design Product (ACP-1): Subject to compliance with requirements, provide Armstrong World Industries, Inc Georgian High Washability, Item 794, or comparable product by one of the following:
1. CertainTeed Corporation.
 2. Chicago Metallic Corporation.
 3. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 2. Pattern: CE (perforated, small holes and lightly textured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.88.
- F. Ceiling Attenuation Class (CAC): Not less than 33.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch (15 mm).

- I. Modular Size: 24 by 24 inches (610 by 610 mm).
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, 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, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 ACOUSTICAL PANELS (ACP-2)

- A. **Basis-of-Design Product (ACP-2): Subject to compliance with requirements, provide Armstrong World Industries, Inc. Cirrus, Item 584, or comparable product by one of the following:**
 - 1. **CertainTeed Corporation.**
 - 2. **Chicago Metallic Corporation.**
 - 3. **USG Corporation.**
- B. **Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.**
- C. **Classification: Provide panels as follows:**
 - 1. **Type and Form: Type III, mineral base with painted finish; Form 1, nodular.**
 - 2. **Pattern: E (lightly textured).**
- D. **Color: White.**
- E. **Noise Reduction Coefficient (NRC): Not less than 0.70**
- F. **Light Reflectance (LR): Not less than 0.86.**
- G. **Ceiling Attenuation Class (CAC): Not less than 35.**
- H. **Edge/Joint Detail: Tegular (Reveal sized to fit flange of exposed suspension-system members).**
- I. **Thickness: 3/4 inch (19 mm).**
- J. **Modular Size: 24 by 24 inches (600 by 600 mm).**
- K. **Antimicrobial Treatment: Manufacturer's standard broad spectrum, 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, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.**

2.42.5 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc Prelude ML or comparable product by one of the following:
1. CertainTeed Corporation.
 2. Chicago Metallic Corporation.
 3. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
1. Structural Classification: Heavy-duty system.
 2. End Condition of Cross Runners: Butt-edge type.
 3. Face Design: Flat, flush.
 4. Cap Material: Cold-rolled steel.
 5. Cap Finish: Painted white.

2.52.6 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated.
1. 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.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
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. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 4. Size: Wire diameter sufficient for 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 not less than 0.135-inch- (3.5-mm-) diameter wire.

2.62.7 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc compatible products or comparable products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Chicago Metallic Corporation.
 - 3. USG Corporation.
- 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. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.72.8 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 07 92 00 "Joint Sealants."

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 unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.
- 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 to structure 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. 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.
 - 6. 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.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 - 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. 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 (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. 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 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.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 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.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 61 13 - FLOOR SEALERS**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 clear penetrating liquid floor treatment for floors indicated in the Finish Schedules.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide products that comply with the following requirements:
 - 1. VOC compliant.
 - 2. Oil and chemical resistance.
 - 3. Eliminates dusting of concrete surfaces.
 - 4. Maintains slip resistance of 0.80 dry and 0.69 wet.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for floor sealers.
- B. Samples: 12 inch (300 mm) square sample of material on concrete surface.

1.5 QUALITY ASSURANCE

- A. Mockups: Cast mockup using project concrete. Replicate joints, surface finish, texture, color, and standard of workmanship of the in-place untreated concrete.
 - 1. Build mockups in the location and of the size as directed by Architect.
 - 2. Apply concrete sealers to demonstrate quality of workmanship for the in place application.
 - 3. Obtain Architect's approval of mockups before starting construction.
 - 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
 - 5. The Owner shall be given the opportunity to accept and approve the slip resistance of the sealed concrete prescribed by the Owner's insurance and legal counsels.
 - 6. Demolish and remove approved mockups at the completion of the project.

- B. Qualifications: Engage an experienced applicator that employs only persons trained and approved by sealer manufacturer.
- C. Concrete Finishing: Comply with requirements of ACI 302 and Sheet S1.01, General Notes.

1.6 JOB CONDITIONS

- A. Weather Conditions: Proceed with installation when weather conditions are in compliance with manufacturer's recommended limitations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Penetrating and Densifying Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic lithium, silicate, or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ChemTec Int'l; ChemTec One.
 - b. Curecrete Distribution Inc.; Ashford Formula.
 - c. Euclid Chemical Company (The); an RPM company; Ultra LI+.
 - d. L&M Construction Chemicals, Inc; Seal Hard.
 - e. PROSOCO, Inc; Consolideck LS.
 - f. W. R. Meadows, Inc; LIQUI-HARD.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with manufacturer's instructions for preparation of substrates to receive floor sealer.
- B. Clean all floor surfaces of old paint, trash, concrete spillage, etc. to ensure concrete slab to be sealed is restored to original condition.
- C. Mask off adjoining surfaces not to receive floor sealer and close off floor drains, to prevent spillage and migration of liquid materials outside membrane area.

3.2 INSTALLATION

- 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.

3.3 PROTECTION

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 09 61 13

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Resilient thermoset-rubber base.
 - 2. Rubber molding accessories.
- B. Related Sections:
 - 1. Section 09 68 13 "Tile Carpeting" for modular carpeting which transitions to concrete floors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.
- C. Product Schedule: For resilient products. Use same designations indicated in the Finish Legend.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

- B. Source Limitations: Obtain each type and color of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F (10 and 32 deg C).
- C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.7 FIELD CONDITIONS

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. For resilient products installed on traffic surfaces, close spaces to traffic during installation and for time period after installation recommended in writing by manufacturer.
- D. Coordinate resilient product installation with other construction to minimize possibility of damage and soiling during remainder of construction period. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE (R)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Roppe Corporation, USA Pinnacle Rubber Base or comparable product by one of the following:
 - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 2. Flexco.

3. Johnsonite; a Tarkett company.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset).
1. Group: I (solid, homogeneous).
 2. Style and Location:
 - a. Style A, No Toe (Straight): Provide in areas with modular carpeting.
 - b. Style B, Standard Toe: Provide in areas with floor sealer and VCT.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (100 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Color: 123 Charcoal.

2.2 RUBBER MOLDING ACCESSORY

- A. Basis of Design: Subject to compliance with requirements, provide Roppe Corporation, USA, Rubber Accessories or comparable products by one of the following:
1. VPI Corporation.
- B. Description: Rubber carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, and joiner for tile and carpet, and transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories at changes in flooring types. Refer to details on the Drawings.
- E. Color: 123 Charcoal.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant, VOC free, type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Available products include the following:

- a. Excelsior Products C-630 Water-Based Contact Adhesive
 - 1) VOC content: 0.0 g/L.

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. General: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before installing resilient products. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 RESILIENT BASE INSTALLATION

- A. General: Install wall base products according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 3. Do not stretch base during installation.

4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- C. Job-Formed Corners:
1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) 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 (76 mm) 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 and aluminum 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. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

3.5 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 2. Sweep or vacuum horizontal surfaces thoroughly.
 3. Do not wash resilient products until after time period recommended by resilient product manufacturer.
 4. Damp-mop or sponge resilient products to remove marks and soil.
- B. Protect resilient products against mars, marks, indentations, and other 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 resilient product manufacturer.
 1. Cover resilient products installed on floors with undyed, untreated building paper until inspection for Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 66 - RESILIENT ATHLETIC FLOORING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubber floor tile.
- B. Related Requirements:
 - 1. Section 09 65 13 "Resilient Base and Accessories" for wall base and accessories installed with resilient athletic flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details and locations of the following:
 - 1. Locations of floor inserts for athletic equipment installed through flooring.
- C. Samples: For each exposed product and for each type, color, and pattern specified, 6-inch- (150-mm-) square in size and of the same thickness indicated for the Work.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Tile: Furnish no fewer than 2 boxes for each 50 boxes or fraction thereof, of each type, color, pattern, and size of floor tile installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration.
 - 1. Store tiles on flat surfaces.

1.7 FIELD CONDITIONS

- A. Adhesively Applied Products:
 - 1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
 - 3. Close spaces to traffic during flooring installation.
 - 4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS****2.2 RUBBER FLOOR TILE**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mondo America Inc. Ramflex or comparable product by one of the following:
 - 1. Flexco.
 - 2. Johnsonite; a Tarkett company.
 - 3. Regupol America.
 - 4. Roppe Corporation, USA.
 - 5. Tarkett Sports; a division of the Tarkett Group.
- B. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.
- C. Material: Natural and synthetic rubbers in two layers vulcanized together.
- D. Thickness: 0.0394 inch (10 mm).

- E. Traffic-Surface Texture: Hammered.
- F. Size: 36 inches (914 mm) square.
- G. Color and Pattern: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
- B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
- C. Reducers: Rubber edge for glue-down applications, nosing for resilient athletic floor covering.
 - 1. Basis of Design: Subject to compliance with requirements, provide Roppe Corporation, USA, Rubber Accessories Reducer #26 or comparable products by the following:
 - a. VPI Corporation.
 - 2. Locations: Provide rubber reducers at transitions from resilient athletic flooring to concrete surfaces and at each opening.
 - 3. Color: 123 Charcoal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, 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.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 10.0.

3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. 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. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
 1. Do not install flooring until it is the same temperature as space where it is to be installed.
- F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.
- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 FLOOR TILE INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room axis.
- B. Discard torn, cracked, chipped, or deformed tiles.

- C. Tile Matching: Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.
 - 1. Lay tiles with grain running in one direction.
- D. Adhered Floor Tile: Adhere products to substrates according to adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times. Method of application shall be determined based on the conditions and intended use of the flooring system.
 - 1. Apply full ribbon of adhesive at each side of seams. Completely cover each seam with weights for a minimum of 72 hours to ensure full adhesion and flatness.
 - 2. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing flooring installation:
 - 1. Remove adhesive and other blemishes from flooring surfaces.
 - 2. Sweep and vacuum flooring thoroughly.
 - 3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Prohibit foot traffic on the material for a period of 24 hours after the installation and for a longer period of time if the temperature is below 72°F (22°C).
- C. Prohibit heavy traffic or rolling loads for a period of 72 hours.
- D. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
 - 1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 09 65 66

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SECTION 09 68 13 - TILE CARPETING**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 modular carpet tile and walk-off carpet tile
- B. Related Requirements:
 - 1. Section 09 65 19 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.

8. Type, color, and location of insets and borders.
 9. Type, color, and location of edge, transition, and other accessory strips.
 10. Transition details to other flooring materials.
- C. Samples: 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.
 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.6 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.

1.7 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. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 1. Build mockups at locations and in sizes 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" 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 levels planned for building occupants 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, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 WALK-OFF CARPET TILE (Walk-Off CPT)**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide J&J Invision; J&J Industries, Inc., Catwalk Walk-Off Modular 7010 or comparable product by one of the following:
 - 1. Bentley Prince Street, Inc.
 - 2. Interface, LLC.
 - 3. Mannington Mills, Inc.
 - 4. Milliken & Company.
 - 5. Mohawk Group (The); Mohawk Carpet, LLC.
 - 6. Patcraft; a division of Shaw Industries, Inc.

7. Philadelphia Commercial; a division of Shaw Industries, Inc.
 8. Shaw Contract Group; a Berkshire Hathaway Company.
 9. Tandus; a Tarkett company.
- B. Colors: Spotlight 1427.
- C. Construction: Textured patterned loop.
- D. Fiber Type: "Encore SD."
- E. Face Weight: 34 oz/sq yd (1,153 g/m²)
- F. Gauge: 1/8 (3.15 rows/cm).
- G. Stitches: 9.5/in (3.74/cm)
- H. Primary Backing/Backcoating: Manufacturer's standard synthetic materials.
- I. Secondary Backing: Manufacturer's standard material.
- J. Size: 24 by 24 inches (610 by 610 mm).
- K. Applied Treatments:
1. Soil-Resistance Treatment: Manufacturer's standard treatment.
- L. Performance Characteristics:
1. Electrostatic Propensity: Less than 3.0 kV according to AATCC 134.

2.2 CARPET TILE (CPT1)

- A. Basis-of-Design Products: The design is based on the designated products. Subject to compliance with requirements, provide either the named products or comparable products by one of the other manufacturers specified. Comparable products are subject to review and approval through the submittal process specified.
1. Color 1: Subject to compliance with requirements, provide J&J Invision; J&J Industries, Inc., Fiction Modular 7025, Anti-Climax 1771.
 2. Color 2 - Accent: Subject to compliance with requirements, provide J&J Invision; J&J Industries, Inc., Index Demi-Plank 7009," Works 1836.
- 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. Bentley Prince Street, Inc.
 2. Interface, LLC.
 3. Mannington Mills, Inc.
 4. Milliken & Company.
 5. Mohawk Group (The); Mohawk Carpet, LLC.
 6. Patcraft; a division of Shaw Industries, Inc.

7. Philadelphia Commercial; a division of Shaw Industries, Inc.
 8. Tandus; a Tarkett company.
- C. Construction: Textured patterned loop.
- D. Fiber Type: "Encore BCF."
- E. Face Weight: 19 oz/sq yd (644 g/m²)
- F. Gauge: 1/12 (4.72 rows/cm).
- G. Stitches: 10/in (3.94/cm)
- H. Primary Backing/Backcoating: Manufacturer's standard synthetic materials.
- I. Secondary Backing: Manufacturer's standard material.
- J. Sizes:
1. Color 1: 24 by 24 inches (610 by 610 mm)
 2. Color 2: 12 by 48 inches (305 by 1219 mm).
- K. Applied Treatments:
1. Soil-Resistance Treatment: Manufacturer's standard treatment.
- L. Performance Characteristics:
1. Electrostatic Propensity: Less than 3.0 kV according to AATCC 134.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

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.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. 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. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- 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 (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: 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 adhesive and carpet tile manufacturers.
- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings.
- 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 carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive 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.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. 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.

END OF SECTION 09 68 13

SECTION 09 68 23 - SYNTHETIC TURF CARPETING**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. Synthetic turf for indoor running surfaces.
- B. Related Requirements:
 - 1. Section 09 56 66 "Resilient Athletic Flooring" for interfaces between the various flooring materials.

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. Submit manufacturer's specifications and installation instructions.
- B. Shop Drawings: Submit shop drawings indicating layout of seams, markings edge details and methods of attachment.
- C. Samples: Submit samples of synthetic turf materials including related installation accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each synthetic grass surfacing assembly.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.
- E. Submit written certification indicating the acceptance of concrete substrate as follows:

1. Finished surface is suitable for the application of the selected synthetic turf system.
2. Substrate is suitable for installation of synthetic turf.
3. Warrant athletic surface installation for the period and conditions specified herein.

1.6 CLOSEOUT SUBMITTALS

- A. Provide a written acceptance by the Turf Manufacturer that the turf and base system is installed in accordance with their recommendations prior to final completion.
- B. Maintenance Data: For synthetic turf carpeting, including maintenance cleaning instructions, to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Turf Fabric: Minimum of 300 sq. ft. (28 sq. m) for each type indicated.
 2. One new set of maintenance tools, of type recommended by synthetic grass surfacing manufacturer for installation.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Fire Rating: Comply with DOC FF-1, methenamine pill test.

1.9 DELIVERY, STORAGE & HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."
- B. Deliver products to site in original containers and wrappers as agreed between the Engineer and Contractor. Inspect products upon delivery for damage.
- C. Store products in a location and in a position that protects them from crush damage or any other defects.
- D. Handle and store (on and off site) all materials safely to ensure their physical properties are not adversely affected and that they are not subject to vandalism or damage.
- E. Adhesives shall arrive in dry, sealed containers.

1.10 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

- B. Environmental Limitations: Do not deliver or install turf carpeting until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install turf carpeting over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have moisture vapor emission range recommended by carpet tile manufacturer.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration and excessive wear.
 - b. Deterioration from UV light.
 - c. Excessive loss of shock attenuation.
 - d. Seam separation.
 - 2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Turf Fabric: Turf fabric tested according to the following methods, with additional test method conditions for each method according to ASTM F 1551.
 - 1. Tuft Bind: Not less than 8 lbs (3.63 kg) according to ASTM D 1335.
 - 2. Tensile Strength: Minimum 8 lbs (3.63. kg), according to ASTM D 5034.
- B. Synthetic Grass Surfacing: Assembly tested according to the following methods, with additional test method conditions for each method according to ASTM F 1551.
 - 1. Shock Attenuation: No greater than 170 G(max) at time of installation according to ASTM F 355.
 - 2. Abrasiveness Index: 20.2 according to ASTM F 1015.

2.2 SYNTHETIC TURF

- A. Synthetic Grass Surfacing: Complete surfacing system, consisting of synthetic yarns bound to water-permeable backing indicated, suitable for multipurpose sport indoor surfaces.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Sporturf International Division of Controlled Products, LLC Fast Grass AT740 or comparable product by one of the following:

- a. FieldTurf, a Tarkett Sports Company.
 - b. Shaw Sports Turf Division of Berkshire Hathaway.
 - c. Sprinturf, an Integrated Turf Solutions Company.
- B. Turf Fabric: Woven turf fabric with multicolored fiber and UV resistance, complying with the following:
1. Yarn Fiber: Slit-film polyethylene and texturized nylon.
 2. Lead Content of Yarn Fiber: Maximum of 100 ppm according to ASTM F 2765.
 3. Pile Weight: 40 oz./sq. yd. (1356 g/sq. m) according to ASTM D 5848.
 4. Pile Height: 3/4 inches (19 mm) according to ASTM D 5823.
- C. Backing Material:
1. Primary Backing: Dual layered woven polypropylene material.
 - a. System Weight: 7.0 ounces/square yard.
 2. Secondary Backing:
 - a. Secondary backing system weight must be a minimum of 75 ounces/square yard.
- D. Fabric surface:
1. Minimum width: 12 feet (3.66 m) with no longitudinal or transverse seams.
 2. Seams shall be 12'-0" (3.66 m) apart.
- E. Adhesives: Manufacturer's recommended VOC compliant materials.
- F. Auxiliary Materials: Provide fastenings, inserts, and other items recommended by turf 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 turf carpeting performance.
- B. Examine grass turf carpeting for type, color, and potential defects.
- C. Concrete Slabs: Verify that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

- a. 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. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with turf carpeting manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- 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 (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: 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 adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing turf carpeting.

3.3 INSTALLATION

- A. Comply with CRI's "CRI Carpet Installation Standard" and turf carpeting manufacturer's written installation instructions for the following:
 1. Direct-glue-down installation.
- B. Ensure edges and seams are securely adhered. Apply seam sealer to secure cut edges of turf material at both seams and exposed edges of turf.
- C. Remove backing pad and turn down finish turf surfaces at edges of substrate and at transitions to unfinished concrete to provide finish edges.

3.4 CLEANING AND COMPLETION

- A. Protect all installed work from other construction activities as installation progresses.
- B. Maintain the area clean throughout the construction period and free from the installation process.

- C. Upon completion of the installation, thoroughly clean surfaces and site of all refuse resulting from the installation process.
- D. Any damage to existing fixtures or facilities resulting from the installation of the synthetic turf system shall be repaired to original condition at the Contractor's expense prior to Substantial Completion and commencement of the Warranty Period.
- E. A deficiency list will be produced by the Engineer at the conclusion of the project. All installation project deficiencies not in dispute must be remedied by the Contractor prior to the issuance of a certificate of Substantial Completion.

END OF SECTION 09 68 23

SECTION 09 91 13 - EXTERIOR PAINTING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
1. Concrete.
 2. Fiber-cement board.
 3. Concrete masonry units (CMUs).
 4. Steel and iron.
 5. Galvanized metal.
 6. Wood.
- B. Related Requirements:
1. Section 05 12 00 "Structural Steel Framing" for shop priming of metal substrates.
 2. Section 05 50 00 "Metal Fabrications" for shop priming metal fabrications.
 3. Section 05 52 13 "Pipe and Tube Railings" for shop priming pipe and tube railings.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
- B. Gloss Levels: The following gloss designations as determined in accordance with ASTM D 523 apply to paint products specified in this Section:
1. "Flat" refers to a lusterless or matte finish with a gloss range below 5 when measured at a 60-degree meter.
 2. "Eggshell" refers to low-sheen finish with a gloss range between 10 and 20 when measured at a 60-degree meter.
 3. "Satin" refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 4. "Semi-Gloss" refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 5. "Gloss" refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: 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, 8 inches (200 mm) 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.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations for Field Applied Systems: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
 - 1. Applicator shall verify compatibility of field applied materials with shop applied primers. Application of finish coat establishes acceptance of primed surfaces.
- C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in Painting and Decorating Contractors of America (PDCA) P5. Duplicate finish of approved Samples.
 - 1. Surface-Preparation Mockups: On existing surfaces using applicable specified methods of cleaning and other surface preparation, provide mockup sample of at least 10 sq. ft. (0.9 sq. m).
 - 2. Painting Benchmarks: Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
 - a. Wall Surfaces: Provide samples on at least 100 square feet (9 sq. m).
 - b. Small Areas and Items: Architect will designate an item or area required.

3. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
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. Final approval of colors will be from benchmark samples.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. Volatile Organic Content (VOC).
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT 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 topcoat manufacturers for use in paint system and on substrate indicated.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.2 PAINT COLORS

- A. Basis-of-Design Colors: The design is based on the colors indicated by manufacturer's designations in the Finish Schedule Legend. Subject to compliance with requirements, provide exact duplicates of the named colors.

2.3 PAINT MATERIALS

- A. Basis-of-Design Products: The design for each type of paint is based on the products named. Subject to compliance with requirements, provide either the named products or comparable products by one of the following:
1. Benjamin Moore & Co.
 2. PPG Industries, Inc.
 3. Sherwin-Williams Co.
 4. Tnemec, Inc.
- B. Primers:
1. Multi-Purpose Interior/Exterior Latex Primer/Sealer: Sherwin Williams, "B51-450 Series."
 2. Latex Block Filler: Sherwin Williams, "PrepRite Block Filler"
 3. Miscellaneous Metals and Steel Rust Inhibiting Primer: Sherwin-Williams "Pro-Industrial B66-310 Series.
 4. Galvanized Steel and Non-Ferrous Metal Primer: Sherwin Williams: "Macropoxy 646-Fast Cure Epoxy, B58-600/B58V600."
 5. Organic Zinc Rich Primer: Sherwin Williams "Zinc-Clad IIIHS";
- C. Exterior intermediate Paint Materials:
1. High Build Polyamide Epoxy, Sherwin Williams "Recoatable Epoxy Primer."
- D. Exterior Finish Paint Materials:

1. Semi-Gloss Acrylic Polymer: Sherwin Williams, "Sher-Cryl HPA, B66-350."
2. Semi-Gloss Aliphatic Acrylic Polyurethane: Sherwin Williams, "Hi-Solids Polyurethane 100, B65-630."

2.4 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections under which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.
- C. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Fiber-Cement Board: 12 percent.
 3. Masonry: 12 percent.
 4. Wood: 15 percent.
- 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. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- 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 reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 1. SSPC-SP 7/NACE No. 4.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.

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.
- K. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain paint before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
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.
 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.
- E. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
 - a. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.

- b. Brush out and work brush coats into surfaces in an even film.
 - c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.
 3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
 - a. Use airless or air-assisted spray equipment with orifice size recommended by manufacturer for material and texture required.
 - b. Apply each coat to provide the equivalent hiding of brush-applied coats.
 - c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.
- F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer. Finish coats shall be provided in the dry film thickness specified in the schedules located at the end of this Section.
- G. Mechanical items to be painted include, but are not limited to, the following:
 1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- H. Electrical items to be painted include, but are not limited to, the following:
 1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- I. Block Fillers: Apply block fillers to concrete masonry and cast-in-place concrete at a rate to ensure complete coverage with all pores filled.
- J. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to substrates that are required to be painted or finished and that have not been prime coated by others.
 1. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- K. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holi-

days, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

1. Apply additional coats as required to provide a completely opaque and uniform finish surface.
 2. Deep and accent clear-base colors may require 1-2 more coats to achieve the proper hide
- L. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.
- M. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

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 SHOP APPLIED METAL PRIMER SCHEDULE

- A. General: Provide the following paint system for the various substrates indicated.
- B. Structural Steel Framing:
1. Primer: Organic zinc rich primer (3 mils)

- C. Non-Galvanized Ferrous Metal Shapes and Plates:
 - 1. Primer: Rust Inhibiting Primer (3 mils)
- D. Galvanized Surfaces, including Railings and Miscellaneous Shapes and Plates:
 - 1. Primer: Galvanized Steel and Non-Ferrous Metal Primer (4 mils)

3.7 EXTERIOR PAINT SCHEDULE

- A. General: Provide the following paint system for the various substrates indicated.
- B. Non-Galvanized and Shop-Primed Ferrous Metal (Including Hollow Metal Doors):
 - 1. Acrylic: Three coats
 - a. Primer: Rust Inhibiting Primer (Primer is not required on shop primed items. Shop primer may require field touchup.)
 - b. First Coat: Semi-Gloss Acrylic Polymer (3 mils)
 - c. Second Coat: Semi-Gloss Acrylic Polymer (3 mils)
- C. Aluminum and Galvanized Sheet Metal:
 - 1. Acrylic: Three coats
 - a. Primer: Galvanized Steel and Non-Ferrous Metal Primer
 - b. First Coat: Semi-Gloss Acrylic Polymer (3 mils)
 - c. Second Coat: Semi-Gloss Acrylic Polymer (3 mils)
- D. Galvanized Miscellaneous Shapes and Plates:
 - 1. Polyurethane Finish: Two coats
 - a. Primer: Galvanized Steel and Non-Ferrous Metal Primer (4 mils)
 - b. Finish Coat: Semi-Gloss Aliphatic Acrylic Polyurethane (4 mils)
- E. Shop Primed Structural Steel and Railings: Miscellaneous Shapes and Plates with Organic Zinc Rich Primer:
 - 1. Polyurethane Finish: Two coats
 - a. Intermediate: Intermediate for Shop Primed Structural Steel (6 mils)
 - b. Finish Coat: Semi-Gloss Aliphatic Acrylic Polyurethane (4 mils)

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
1. Concrete.
 2. Concrete masonry units (CMUs).
 3. Steel and iron.
 4. Galvanized metal.
 5. Gypsum board.
 6. Wood surfaces.

1.3 DEFINITIONS

- A. Gloss Levels: The following gloss designations as determined in accordance with ASTM D 523 apply to paint products specified in this Section:
1. "Flat" refers to a lusterless or matte finish with a gloss range below 5 when measured at a 60-degree meter.
 2. "Eggshell" refers to low-sheen finish with a gloss range between 10 and 20 when measured at a 60-degree meter.
 3. "Satin" refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 4. "Semi-Gloss" refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 5. "Gloss" refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.
- B. Areas Subject to Moisture: These spaces are those that have permanent plumbing connections and appliances. These include, but are not limited to, toilet rooms, janitor's closets, locker rooms, shower rooms, training rooms, and laundries.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
1. Indicate VOC content.

- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 INFORMATIONAL SUBMITTALS

- A. Test results: Provide detailed records of results of each of the physical and visual tests used in determining the suitability of the existing painted surfaces for overcoating.

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. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in Painting and Decorating Contractors of America (PDCA) P5. Duplicate finish of approved Samples.
 - 1. Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
 - a. Wall Surfaces: Provide samples on at least 100 square feet (9 sq. m).
 - b. Small Areas and Items: Architect will designate an item or area required.
 - 2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
 - a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.
 - 3. Final approval of colors will be from benchmark samples.

1.8 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 (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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. Benjamin Moore & Co.
 2. Dulux (formerly ICI Paints); a brand of AkzoNobel.
 3. PPG Architectural Coatings.
 4. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.
 5. Sherwin-Williams Company (The).
 6. Tnemec, Inc.

2.2 PAINT, 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.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
- C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicat-

ed. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.3 PAINT COLORS

- A. Basis-of-Design Colors: The design is based on the colors indicated by manufacturer's designations in the Finish Schedule Legend. Subject to compliance with requirements, provide exact duplicates of the named colors.
- B. Colors: Match Architect's samples.

2.4 PAINT MATERIALS

- A. Basis-of-Design Products: The design for each type of paint is based on the products named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
- B. Primers:
 1. Water-Based Epoxy Block Filler: Tnemec Series 1254, Epoxoblock WB, Color 1202 Off-White.
 2. Polyamine Epoxy Primer: Tnemec Series 201 "Epoxoprime."
 3. Rust Inhibiting Primer for Non-Galvanized Ferrous Metal: Tnemec Series 135 "Chem-build."
 4. Wood Primer: Tnemec Series V10 "Tnemec Primers," Color 1009 Gray.
 5. Latex Based Interior Primer: Sherwin-Williams ProMar 200, "Interior Latex Primer, B28W02600."
- C. Interior Finish Coat Material:
 1. Gloss Acrylic Polymer: Tnemec Series 1028 "Enduratone."
 2. Semi-Gloss Acrylic Polymer: Tnemec Series 1029 "Enduratone."
 3. Gloss Epoxy Finish: Two component, high-performance, modified polyamine epoxy coating: Tnemec, Series 280 "Tneme-Glaze."
 4. Satin Water-Based Epoxy Finish: Tnemec, Series 27WB, Typoxy.
 5. Latex-based Interior Semi-Gloss: Sherwin Williams "ProMar 200 Zero Interior Latex, Series B31-2600."
 6. Latex-based Interior Eggshell: Sherwin Williams "ProMar 200 Zero Interior Latex, Series B20-2600."

2.5 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 1. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
 2. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 3. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Testing of existing masonry surfaces: Applicator shall evaluate the existing paint systems to determine if surfaces are acceptable for overcoating. Issues to be addressed included, but are not limited to, total film thickness, number of coats, quality of adhesion to the substrate and between coats, and defects in the film.
 1. Perform the following physical tests at a minimum of 3 locations for the corridors and 3 locations in toilet rooms:
 - a. Measure total dry film thickness and number of coats with a Tooke gauge.
 - b. Visually inspect the film for defects such as delamination, cracking and blistering.
 - c. Check adhesion at the same locations where dry film thickness readings were taken, using the following adhesion test methods:
 - 1) "X" Scribe and Tape Test - Conduct this test in accordance with ASTM D 3359 Standard Test Methods for Measuring Adhesion by Tape Test, Method A.
 - 2) Knife Adhesion – Probe at the coating with the point of a knife blade in an attempt to delaminate the coating system between coats or from the substrate.
 2. Document the results of each test.

- C. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
 2. Fiber-Cement Board: 12 percent.
 3. Masonry: 12 percent.
 4. Wood: 15 percent.
 5. Gypsum Board: 12 percent.
- D. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

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 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.
 2. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare concrete and concrete masonry surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

- a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - c. If transparent finish is required, backprime with spar varnish.
 - d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
 - e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with surface preparation specifications prepared by The Society for Protective Coatings (SSPC).
 - a. Abrasive blast clean steel surfaces as recommended by paint system manufacturer and according to requirements of SSPC-SP 6, Commercial Blast Cleaning.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
 6. 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.
- E. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain paint before using.
 3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. 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.
 2. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
 - a. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
 - b. Brush out and work brush coats into surfaces in an even film.
 - c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.
 3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
 - a. Use airless or air-assisted spray equipment with orifice size recommended by manufacturer for material and texture required.
 - b. Apply each coat to provide the equivalent hiding of brush-applied coats.
 - c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.
- C. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer. Finish coats shall be provided in the dry film thickness specified in the schedules located at the end of this Section.
- D. Block Fillers: Apply block fillers to concrete masonry and cast-in-place concrete at a rate to ensure complete coverage with all pores filled.
- E. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to substrates that are required to be painted or finished and that have not been prime coated by others.

1. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- F. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
1. Apply additional coats as required to provide a completely opaque and uniform finish surface.
 2. Deep and accent clear-base colors may require 1-2 more coats to achieve the proper hide
- G. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- H. 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. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in Painting and Decorating Contractors of America (PDCA) Specification P1.

3.6 INTERIOR PAINT SCHEDULE

- A. General: Provide the designated paint systems for the various substrates, as indicated in the Room Finish Schedule.
- B. Concrete Masonry Units in Corridors:
 - 1. Water Based Epoxy: Three coats
 - a. Block Filler: Block Filler, for uncoated surfaces only.
 - b. First Coat: Satin Water-Based Epoxy (4-6 mils)
 - c. Second Coat: Satin Water-Based Epoxy (4-6 mils)
- C. Concrete Masonry Units in Areas Subject to Moisture:
 - 1. Gloss Epoxy Coating:
 - a. Block Filler: Block Filler, for uncoated surfaces only.
 - b. First Coat: Gloss Epoxy Finish (6-8 mils)
 - c. Second Coat: Gloss Epoxy Finish (6-8 mils)
- D. Gypsum Board Walls and Partitions (Not Subject to Moisture and Food Preparation):
 - 1. Eggshell Enamel Finish: Three coats
 - a. Primer: Latex-based Interior Primer
 - b. First Coat: Latex-based Interior Eggshell (1.7 mils)
 - c. Second Coat: Latex-based Interior Eggshell (1.7 mils)
- E. Non-Galvanized Ferrous Metal:
 - 1. Acrylic: Three coats
 - a. Primer: Rust Inhibiting Primer (Primer is not required on shop primed items. Shop primer may require field touchup.)
 - b. First Coat: Semi-Gloss Acrylic Polymer (3 mils)
 - c. Second Coat: Semi-Gloss Acrylic Polymer (3 mils)
- F. Painted Woodwork: Provide the following painted finishes for new interior woodwork
 - 1. Acrylic: Three coats
 - a. Primer: Wood Primer (2-3 mils)
 - b. First Coat: Gloss Acrylic Polymer (2-3 mils)
 - c. Second Coat: Gloss Acrylic Polymer (2-3 mils)

END OF SECTION 09 91 23

SECTION 10 28 00 - TOILET AND BATH ACCESSORIES**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Washroom and shower accessories.
 - 2. Childcare accessories.
 - 3. Underlavatory guards.
 - 4. Custodial accessories.

1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Samples: Full size, for each exposed product and for each finish specified.
 - 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

PART 2 - PRODUCTS**2.1 OWNER-FURNISHED MATERIALS**

- A. Owner-Furnished Equipment: The Owner will provide the following items to the Contractor for installation:
1. Liquid-Soap Dispenser.
 2. Paper Towel Dispenser.
 3. Toilet Tissue Dispenser.
 4. Sanitary Napkin Dispenser.
 5. Waste Receptacles.

2.2 WASHROOM AND SHOWER ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Basis-of-Design Products: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
1. A & J Washroom Accessories, Inc.
 2. American Specialties, Inc.
 3. Bobrick Washroom Equipment, Inc.
 4. Bradley Corporation.
 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
- C. Grab Bars: Horizontal Straight Line:
1. Basis-of-Design Product: Bobrick Model B-6806.99.
 2. Mounting: Flanges with concealed fasteners.
 3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
 4. Outside Diameter: 1-1/2 inches (38 mm).
 5. Lengths: As indicated on Drawings.

D. Grab Bars: Horizontal Two-Wall Shower:

1. Basis-of-Design Product: Bobrick Model B-6861.99.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches (38 mm).
5. Lengths: As indicated on Drawings.

E. Grab Bars: Horizontal Two-Wall Wheelchair Toilet Compartment:

1. Basis-of-Design Product: Bobrick Model B-68137.99.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches (38 mm).
5. Lengths: As indicated on Drawings.

F. Sanitary-Napkin Disposal Unit, Dual Access:

1. Basis-of-Design Product: Bobrick Model B-354.
2. Mounting: Partition mounted, dual access.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

G. Sanitary-Napkin Disposal Unit:

1. Basis-of-Design Product: Bobrick Model B-254.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

H. Shelf:

1. Basis-of-Design Product: Bobrick Model B-295
2. Description: With exposed edges turned down not less than 1/2 inch (13 mm) and supported by two triangular brackets welded to shelf underside.
3. Size: 24 inches (610 mm) long by 5 inches (125 mm) deep.
4. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, No. 4 finish (satin).

I. Mirror Units:

1. Basis-of-Design Product: Bobrick Model B-290 2430 and B-290 2470.
2. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.

- a. Corners: Welded and ground smooth.
 3. Integral Shelf: 5 inches (127 mm) deep.
 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.
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
 5. Sizes:
 - a. Over Lavatories: 24 by 30 inches (610 by 760 mm).
 - b. Full Length: 24 by 72 inches (610 by 1830 mm).
- J. Coat Hook:
1. Basis-of-Design Product: Bobrick Model B-677
 2. Description: Single-prong unit.
 3. Material and Finish: Stainless steel, No. 4 finish (satin).
- K. Diaper-Changing Station:
1. Basis-of-Design Product: Bobrick Koala Kare Model KB110-SSRE
 2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250-lb (113-kg) static load when opened.
 3. Mounting: Semirecessed, with unit projecting not more than 1 inch (25 mm) from wall when closed.
 4. Operation: By pneumatic shock-absorbing mechanism.
 5. Material and Finish: Stainless steel, No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners.
 6. Liner Dispenser: Built in.
- L. Shower Curtain Rod:
1. Basis-of-Design Product: Bobrick Model B-6047.
 2. Description: 1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 3. Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
 4. Finish: Stainless steel, No. 4 finish (satin).
- M. Shower Curtain:
1. Basis-of-Design Product: Bobrick Model 204-2 with 204-1 Curtain Hooks.
 2. Size: Minimum 6 inches (152 mm) wider than opening by 72 inches (1828 mm) high.
 3. Material: Vinyl, minimum 0.008 inch (0.2 mm) thick, opaque, matte.
 4. Color: White.

5. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
6. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

N. Robe/Clothes Hook:

1. Basis-of-Design Product: Bobrick Model B-2116
2. Description: Single-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.3 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Materials Subject to compliance with requirements, provide product 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.

2.4 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Mop and Broom Holder with Shelf:

1. Basis-of-Design Product: Bobrick Model B-239 x 34
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 34 inches (865 mm).
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.

2.5 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.6 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 (1112 N), 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 instructions.

END OF SECTION 10 28 00

SECTION 10 41 16 - EMERGENCY KEY CABINETS**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Key storage cabinet for fire/police rapid entry.
- B. Related Section:
 - 1. Section 08 71 00 "Door Hardware" for locksets and key requirements.

1.2 SUBMITTALS

- A. Product Data and manufacturer's standard installation methods and details.
- B. Shop drawings: Include methods of installation differing from manufacturer's standard details. Indicate dimensions, clearances, and depth of recess.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each item through one source from a single manufacturer.

1.4 COORDINATION

- A. Coordinate installation of anchorages for key storage cabinet. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS**2.1 STORAGE CABINET**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Knox Company "Knox Box" 3200 Series or comparable product by another reputable manufacturer.
 - 1. Dimensions: 4 inches (101 mm) high by 5 inches (127 mm) wide by 3-3/4 inches (95.25 mm) deep.
 - 2. Mounting Flange: 7 inches (177.8 mm) high by 7 inches (177.8 mm) wide.
 - 3. Recessed Mounting Kit for Masonry Construction: 6-1/2 inches (165 mm) high x 6-1/2 inches (165 mm) wide by 5 inches (127 mm) deep.
 - 4. Hinges: Stainless steel.
 - 5. Capacity: 10 keys.
 - 6. Color: Black.

7. Lock: Single lock

2.2 MISCELLANEOUS MATERIALS

- A. Fasteners: Use stainless steel concealed fasteners and anchor bolts.

2.3 FABRICATION, GENERAL

- A. Where welding is required, weld joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.
 1. Use welding procedures that will blend with and not cause discoloration of metal being joined.
 2. Weld shop-made joints, and grind and polish surfaces to produce uniform, directionally textured finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instruction, recessed.
- B. Locate and place key storage cabinet level, plumb, and in alignment with adjacent construction.
- C. Use concealed anchorages. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

3.2 ADJUSTING

- A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.3 PROTECTION

- A. Protect finishes of key storage cabinet from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 10 41 16

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES**PART 1 - GENERAL****1.1 SUMMARY**

- A. This Section includes the following:
 - 1. Fire-protection cabinets for portable fire extinguishers.
 - 2. Mounting brackets for fire extinguishers.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Show cabinet door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction and mounting brackets.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINETS

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Specialties, Inc.
 - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - c. Larsens Manufacturing Company.
- B. Cabinet Construction: Nonrated and 1-hour fire rated.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm) thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- D. Recessed Cabinet:
 - 1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
- F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

- G. Cabinet Trim Material: Aluminum sheet.
- H. Door Material: Aluminum sheet.
- I. Door Style: Vertical duo panel with frame.
- J. Door Glazing: Tempered float glass (clear).
- K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed, flush door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- L. Accessories:
 - 1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Pressure-sensitive vinyl letters.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.
- M. Materials:
 - 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel or powder coat.
 - b. Color: White.
 - 2. Aluminum: ASTM B 221 (ASTM B 221M), with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet. ASTM B 221 (ASTM B 221M) for extruded shapes.
 - a. Finish: Clear anodic.
 - 3. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

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, with plated or black baked-enamel finish.

- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. 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.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Fabricate door frames of one-piece construction with edges flanged.
 - 3. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets are to be installed.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.
- B. General: Install mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- C. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, in compliance with the requirements of NFPA 10.
 - 1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
 - 2. Fasten mounting brackets to structure and cabinets, square and plumb.
 - 3. Fasten cabinets to structure, square and plumb.
- D. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
- E. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors to swing and operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 10 44 00

SECTION 10 44 16 - FIRE EXTINGUISHERS**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.
- B. Related Requirements:
 - 1. Section 10 44 13 "Fire Protection Specialties" for cabinets and mounting brackets.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.5 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS**2.1 PERFORMANCE REQUIREMENTS**

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
1. Provide fire extinguishers approved, listed, and labeled by FM Global.

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. Badger Fire Protection
 - b. J.L. Industries, Inc.
 - c. Larsen's Manufacturing Company.
 - d. Potter-Roemer; Div. of Smith Industries, Inc.
 2. Valves: Manufacturer's standard.
 3. Handles and Levers: Stainless steel.
 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- C. Regular Dry-Chemical Type in Steel Container: UL-rated 60-B:C, 10-lb (4.5-kg) nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.
- D. Wet-Chemical Type: UL-rated 2-A:1-B:C:K, 2.5-gal. (9.5-L) nominal capacity, with potassium citrate-based chemical in stainless-steel container; with pressure-indicating gage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 10 44 16

SECTION 11 66 90 - WALL PADS

PART 1 - GENERAL

1.1 SUMMARY

- A. Types of field wall pads include the following:
 - 1. Waferboard backed pads.

1.2 SUBMITTALS

- A. Product specifications for field wall pad components.
- B. Shop drawings for pad construction, and installation details. Indicate field verified dimensions.
- C. Submit manufacturer's standard color samples for initial color selection.
- D. Submit 12 inch (300 mm) square color samples of same fabric material used to fabricate pads.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Draper, Inc. EcoVision Wall Pads or comparable product by one of the following:
 - 1. American Athletic Inc.
 - 2. Promats, Inc.
 - 3. SNA Sports Group

2.2 MATERIALS

- A. Plywood Backing: 7/16 inch waferboard, primed both sides and edges.
- B. Vinyl Covering: 14 oz. laminated polyester vinyl, unbalanced coating - 10 mils top - 4 mils bottom. 1000 denier, 9x9 weft insertion, UV inhibitors.
- C. Filler foam for plywood backed pads: 2 inch thick polyurethane open cell foam, 3.5 lbs./cubic foot density.
- D. "Z" Clip: Aluminum extrusion.
- E. Color: Manufacturer's standard Red.

2.3 MANUFACTURED UNITS

- A. Waferboard Backed Pads: Provide units that are plywood backed with vinyl covering stretched over filler foam and stapled to back of waferboard. Mount to wall with "Z" clips.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install per manufacturer's recommendations and approved shop drawings.
- B. Field Dimensions: Provide screen printed field dimension in five locations.

END OF SECTION 11 66 90

SECTION 13 34 19 - METAL BUILDING 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. Structural-steel framing.
2. Metal roof panels.
3. Thermal insulation.
4. Accessories.

B. Related Requirements:

1. Section 07 42 19 "Insulated Metal Wall Panels."
2. Section 07 71 00 "Roof Specialties" for gutters and downspouts.
3. Section 07 72 00 "Roof Accessories" for roof hatches, roof curbs, and equipment supports.
4. Section 07 72 53 "Snow Guards" for prefabricated devices designed to hold snow on the roof surface.
5. Section 08 11 13 "Hollow Metal Doors and Frames" for personnel doors installed in metal building systems.
6. Section 08 41 13 "Aluminum Framed Entrances and Storefronts" for entry systems and windows installed in metal building systems
7. Section 08 36 13 "Sectional Doors" for overhead doors in metal building systems.
8. Section 08 71 00 "Door Hardware" for hardware and sets required for each door.
9. Section 09 91 00 "Painting" for field application of finish paint materials to exposed surfaces indicated to be painted.

1.3 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.4 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 03 30 00 "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.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to metal building systems including, but not limited to, the following:
 - a. Condition of foundations and other preparatory work performed by other trades.
 - b. Structural load limitations.
 - c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Required tests, inspections, and certifications.
 - e. Unfavorable weather and forecasted weather conditions 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.
 - 4. Review methods and procedures required for coordinating elements of the metal building system that are provided under separate specification sections.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of metal building system component, including shop applied primer.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Metal roof panels.
 - b. Metal wall panels.
 - c. Thermal insulation and vapor-retarder facings.
- 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.
 3. Metal Roof and Wall 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 (1:8):
 - a. Flashing and trim.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For the following products:
 1. Wall Panels: Nominal 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
 2. Flashing and Trim: Nominal 12 inches (300 mm) long. Include fasteners and other exposed accessories.
 3. Vapor-Retarder Facings: Nominal 6-inch- (150-mm-) square Samples.
 4. Accessories: Nominal 12-inch- (300-mm-) long Samples for each type of accessory.
- E. 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.

1.7 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.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.9 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. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.
- E. Benchmarks: Build benchmark to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build benchmark of typical metal roof panel assembly by installing at least 4 full length panels, and eave.
 - a. Include ridge cap and exposed seam termination.
 - 2. Approval of benchmark does not constitute approval of deviations from the Contract Documents contained in benchmarks unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved benchmark may become part of the completed Work.

1.10 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.
- D. 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 foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of foam-plastic materials as rapidly as possible in each area of construction.

1.11 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.

1.12 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Behlen Mfg. Co standard rigid frame building system or comparable product by one of the following:
 1. [Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.](#)
 2. [Chief Buildings; Chief Industries, Inc.](#)
 3. [Metallic Building Company.](#)
 4. [Varco-Pruden Buildings; a division of BlueScope Buildings North America, Inc.](#)
- B. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 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: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and flush-framed girts.
- E. Eave Height: Manufacturer's standard height, as indicated by nominal height on Drawings.
- F. Bay Spacing: As indicated on Drawings.
- G. Roof Slope: 1 inch per 12 inches (1:12).
- H. Roof System: Manufacturer's standard standing-seam, trapezoidal-rib, metal roof panels.
- I. Exterior Insulated Metal Wall System: As specified in Section 07 42 19 "Insulated Metal Wall Panels."

2.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "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."
 - 3. Deflection and Drift Limits: No greater than the following:
 - a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
 - b. Girts: Horizontal deflection of 1/240 of the span.
 - c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
 - d. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
 - e. Lateral Drift: Maximum of 1/240 of the building height.
- 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Structural Performance for Metal Roof 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 0.0005 cfm/sq. ft. (0.0025 L/s per sq. m) when tested according to ASTM E 1680 at the following test-pressure difference:
1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- F. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
1. Test-Pressure Difference: 12 lbf/sq. ft. (578 Pa).
- G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: UL 90.
- H. 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: SH.

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 Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.
 3. Frame Configuration: As indicated on the Drawings.
 4. Exterior Column: Uniform depth.
 5. Rafters: Tapered.
- 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- (64-mm-) 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- (64-mm-) 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 (51-by-51-by-3-mm) structural-steel angles or 1-inch- (25-mm-) diameter, cold-formed structural tubing to stiffen primary-frame flanges.
 6. Sag Bracing: Minimum 1-by-1-by-1/8-inch (25-by-25-by-3-mm) structural-steel angles.
 7. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch (76-by-51-mm), 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. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
 2. 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.
 3. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
 4. 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 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 (345 or 380); or ASTM A 529/A 529M, Grade 50 or 55 (345 or 380).
 4. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B or C, structural tubing.
 5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, SS, Grades 33 through 80 (230 through 550), or HSLAS or HSLAS-F, Grades 50 through 80 (340 through 550); with G60 (Z180) coating designation; mill phosphatized.
 6. Headed Anchor Rods: ASTM A 307, Grade A.
 - a. Configuration: Straight.
 - b. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
 - c. Plate Washers: ASTM A 36/A 36M carbon steel.
 - d. Washers: ASTM F 436 (ASTM F 436M) hardened carbon steel.
 - e. Finish: Plain.
 7. Threaded Rods: ASTM A 36/A 36M or ASTM A 307, Grade A.
 - a. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
 - b. Washers: ASTM A 36/A 36M carbon steel.
 - c. Finish: Plain.
- 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 dark gray primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil (0.025 mm).

- a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil (0.013 mm) on each side.

2.5 BOLTS

- A. Rigid Frame Connections: Provide High Strength Bolts, Nuts and Washers:
 1. Bolts: ASTM A 325 or ASTM A 490 Heavy Hex Structural Type I as required by manufacturer's design.
 2. Washers: ASTM F 436 Type 1 Hardened Steel.
 3. Nuts: ASTM A 563 Grade C Heavy Hex.
 4. Coating: ASTM F 1941 Electrodeposited Yellow Zinc.
- B. Other Connections: Provide High Strength or Machine Bolts as required by manufacturer design:
 1. High Strength Bolts and Nuts:
 - a. Bolts: ASTM A 325 Heavy Hex Structural Type I.
 - b. Nuts: ASTM A 563 Grade C Heavy Hex.
 - c. Coating: ASTM F 1941 Electrodeposited Yellow Zinc.
 2. Machine Bolts:
 - a. Bolts: ASTM A 307 Grade Carbon Steel.
 - b. Nuts: ASTM A 563 Hex Nut Grade A.
 - c. Coating: ASTM F 1941 Electrodeposited Clear Zinc.

2.6 METAL STANDING SEAM ROOF PANELS

- A. Standing-Seam, Trapezoidal-Rib, Metal Roof Panels: Formed with raised trapezoidal ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Behlen Mfg. Co ZL-24 Standing Seam Roof or comparable product by one of the following:
 - a. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
 - b. Chief Buildings; Chief Industries, Inc.
 - c. Metallic Building Company.
 - d. Varco-Pruden Buildings; a division of BlueScope Buildings North America, Inc.
 2. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch (0.76-mm) nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Exterior Finish: Three-coat fluoropolymer.
 - b. Color: As selected by the Architect from manufacturer's standard colors.

3. Clips: Two-piece floating to accommodate thermal movement.
4. Joint Type: Mechanically seamed.
5. Panel Height: 3 inches (76 mm).
6. Uplift Rating: UL 90.

2.7 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. General: Provide insulated metal wall panels as specified in Section 07 42 19 "Insulated Metal Wall Panels."

2.8 THERMAL INSULATION

- A. Insulated Roof Liner System: Interior liner system fabric, support strapping, fasteners, sealants, thermal break materials, and fiberglass insulation.
 1. Basis-of-Design System: Subject to compliance with requirements, provide Thermal Design, Inc. "Simple Saver System" or comparable product by an alternate manufacturer.
- B. Thermal Spacer Blocks: Provide 2 inch (51 mm) polystyrene "Snap-R" thermal blocks.
- C. Glass-Fiber Blanket, Unfaced, Unlaminated: ASTM C 991, 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.
- D. Thermal Performance for Roof Liner System: Provide the following minimum R-values and maximum U-factors and when tested according to ASTM C 518 or ASTM C 1363:
 1. Thermal-Resistance Value (R-Value): 21.4 hr•ft²•°F/Btu according to ASTM C 518.
 2. Thermal Transmittance Value (U-Value): 0.0527 Btu/hr•ft²•°F according to ASTM C 1363.

2.9 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. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46-mm) 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 (0.76-mm) nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- C. Gutters and Downspouts: Provide materials specified in Section 07 71 00 "Roof Specialties."
- D. Louvers: Provide materials indicated on the Mechanical Drawings.
- E. Roof Curbs: Provide materials as indicated in Section 07 72 00 "Roof Accessories."
- F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.
- G. 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 or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 - b. 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.
 - c. 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.
 - d. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 - e. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
 2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 3. 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.

2.10 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.

2.11 SOURCE QUALITY CONTROL

- A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
 - a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

2.12 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 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. 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.
 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 (0.013 mm).

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.
 1. Engage land surveyor to perform surveying.
- 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, 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 STANDING SEAM ROOF 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. 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.
- C. 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.

- D. 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.
- E. 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.
- F. 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 07 92 00 "Joint Sealants."

3.5 METAL STANDING SEAM ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
 2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
 5. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge caps.
- C. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 INSULATED METAL WALL PANEL INSTALLATION

- A. General: Erect insulated metal wall panels as specified in Section 07 42 19 "Insulated Metal Wall Panels."

3.7 THERMAL INSULATION INSTALLATION

- A. Insulated Roof Liner System: Install insulated roof liner system according to manufacturer's written instructions.
- B. Steel Straps: Cut to length and install straps in the pattern and spacings as indicated on the shop drawings immediately below the bottom plane of the purlins. Position the vapor retarder liner system fabric on the strap platform below the bottom plane of the purlins. Fasten straps and system fabric to bottom of purlins and along rafters.
- C. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
1. Insulation: Place blanket insulation on the vapor retarder liner system to the specified thickness and install parallel, between purlins. To achieve specified R-Value, place the upper most layer of insulation over and perpendicular to the purlins as the roof sheeting is applied.
 2. Over-Purlin-with-Spacer-Block Installation: Extend insulation over and perpendicular to top flange of secondary framing with spacer blocks. Install upper most layer of insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.

3.8 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to

form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
- C. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 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.

3.10 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. 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 roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
 - a. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 13 34 19

SECTION 22 00 00 - PLUMBING**PART 1 - GENERAL****1.1 WORK INCLUDED:**

- A. This Section of the Specification includes the furnishing and installation of complete drainage, water supply, plumbing fixtures and other equipment as described herein and as indicated on the Drawings.

1.2 SUBMITTALS:

- A. Submit complete printed catalog and descriptive data for each major piece of equipment, clearly indicating exactly what features, options and accessories are being provided.
- B. See Section 23 01 00.

1.3 SEWER AND WATER CONNECTIONS:

- A. Connections to on site water, sewer and gas services shall be in accordance with the requirements of the 2012 International Plumbing Code and the respective Utility Company. Pay all associated tap and meter fees and costs.
- B. Before any new sewer work is done, the Contractor shall uncover the sewer line where connection is to be made and shall determine the actual elevation. If the actual elevation of the sewer at the point of connection is such that the new drainage line cannot be installed with the required slope to the new fixtures, the matter shall be referred to the Architect as soon as possible.

PART 2 - PRODUCTS**2.1 DRAINAGE AND VENT PIPING:**

- A. Hub-and-Spigot Pipe: Hub-and-spigot cast-iron pipe not larger than 15-inch size shall be service weight ASTM A74, coated. All changes in pipe size of soil, waste, and drain lines shall be made with reduction fittings or reducers. Changes in direction, where space permits, shall be made with long sweep bends, Y-fittings and 1/8 or 1/16-bends, or combination Y and 1/8-bends. Sanitary tee branches and 1/4-bends may be used for connections of branch lines to fixtures and on vertical runs of pipe. Hub-and-spigot cast-iron pipe larger than 15-inch size shall be Type II or III; Grade C, cast-iron pressure pipe.
 - 1. Gasketed Joints: Molded neoprene elastic compression type gaskets. Gaskets shall conform to ASTM C 564, and pipe, fittings, and gaskets shall bear the symbol of the Cast Iron Soil Pipe Institute. Pipe and fittings shall be manufactured with the spigot ends plain

and beveled, and the bells shall be modified to receive the gaskets. Service weight soil pipe and fittings shall be joined with service weight gaskets. Service weight gaskets shall be clearly designated and identified. A lubricant shall be used in making the joints. When the joint is completed, a tight seal shall be formed between the external face of the pipe and the internal face of the bell. Gaskets shall be capable of making and maintaining a tight seal with a deflection not to exceed 5 degrees. Deflection of pipe will not be allowed to avoid the use of a fitting. Joints shall be assembled by the tools and as recommended by the pipe, fittings, and gasket manufacturers.

- B. "N0-Hub" Cast-Iron Pipe: "No-Hub" cast-iron soil pipe and fittings shall conform to Cast Iron Soil Pipe Institute Specification 301 and ASTM A-888. Pipe, fittings, and couplings shall bear the symbol of the Cast Iron Soil Pipe Institute. "No-Hub" piping systems shall be installed in accordance with the manufacturer's recommendations.
- C. Threaded Steel Pipe: Threaded steel pipe shall be galvanized, Schedule 40 conforming to ASTM A 53.
- D. Threaded Copper Nickel Steel Pipe: Threaded copper nickel steel pipe shall conform to ASTM A 714, Grade V, galvanized.
- E. Threaded Cast Iron Pipe: Threaded cast iron pipe shall comply with ASTM A-74.
 - 1. Fittings on threaded ferrous soil, waste, and drain piping, including storm drainage piping and couplings on pipes 6- inches and smaller, shall comply with ANSI B 16.12. Short tee branches and short turn elbows may, except for wall hung water closets, be used for connections of branch lines to fixture and on vertical runs of pipe; long turn fittings shall be used in all other locations where space permits. Fittings may be galvanized or black, coated or uncoated. Couplings on pipes 8-inches and larger shall be standard weight steel, zinc-coated (galvanized) and need not be recessed; steel couplings shall not be used on piping 6- inches and smaller.
 - 2. Fittings on threaded ferrous vent pipes shall comply with ANSI B 16.3, B16.4, or B 16.12. Couplings shall be as specified above for soil, waste, and drain piping.
- F. Copper Tubing: Copper tubings shall be Type M, in accordance with ASTM B-88, or Type DWV in accordance with ASTM B 306. Ends of tubing shall be cut square and shall be reamed before being made up. Tubing ends shall enter the full depth of the fitting recesses without binding.
 - 1. Fittings for copper tubing shall be solder type, recessed drainage pattern, of wrought copper or cast brass. Recesses shall be smooth and correctly sized to provide proper clearance over the tubing. Solder shall be composition 95/5 tin-antimony or Brigit. Flux shall be noncorrosive. Tubing ends and fitting recesses shall be thoroughly cleaned. Solder shall penetrate fully and shall fill the joint completely.
- G. Plastic Pipe and Fittings: Schedule 40 PVC, ASTM D-1784 with solvent welded joints.

2.2 UNDERGROUND WATER PIPING:

- A. Underground domestic water piping beyond five feet outside the building shall be as specified by the Civil Engineer.

B. Underground water piping beneath the building to a point five feet outside the building shall be one of the following:

1. Cross-linked polyethylene (PEX).

a. Material Standard: Manufactured in accordance with ASTM F876 and ASTM F877 and tested for compliance by an independent third party agency.

- 1) Standard grade hydrostatic design and pressure ratings from Plastic Pipe Institute.
- 2) Minimum Bend Radius (cold bending): No less than 6 times the outside diameter. Use a bend support as supplied by the PEX tubing manufacturer for tubing with a bend radius less than stated.
- 3) Nominal Inside Diameter: Provide tubing with nominal inside diameter, in accordance with ASTM F876.

b. Fittings:

- 1) Joints below grade shall be avoided if possible.
- 2) Fittings shall be of a type approved by the piping manufacturer for the application, and shall be supplied by piping manufacturer.
- 3) Material: Fittings shall be suitable for direct burial in earth, and shall be manufactured from one of the following –
- 4) Same material as piping.
- 5) Polyalloy (ASTM 2359).
- 6) Bronze (w/ stainless steel sleeve) (ASTM 877).
- 7) Dezincified brass (ASTM 1807).
- 8) Material Standard: Comply with ASTM F1960.

c. Accessories

- 1) Bend supports designed for maintaining tight radius bends shall be supplied by the PEX tubing manufacturer.
- 2) Tools required to install the piping fittings shall be supplied by the PEX tubing manufacturer.
- 3) The tubing manufacturer will provide clips and/or PEX rails for supporting tubing runs.

d. Warranty:

- 1) Warranty Period for PEX piping and fitting system shall be 25-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.

e. Acceptable Manufacturers – Mr. Pex, Uponor, Viega.

2. Copper tubing, Type K, soft drawn, ASTM B-88.

a. Joints below grade shall be avoided if possible.

b. Where necessary, joints below grade shall utilize fittings of the recessed solder-joint type of either wrought copper or cast brass. Solder shall be silver solder

having a melting point of not less than 1120°F. Adapters for connection to threaded valves, fittings, meters and other equipment shall be cast brass. Recesses shall be smooth and correctly sized to provide proper clearance over the tubing.

2.3 ABOVEGROUND WATER PIPING:

- A. Aboveground domestic water piping 3-inches in size and smaller, shall be copper tubing, Type L, hard drawn, ASTM B-88. Fittings shall be one of the following:
1. Recessed solder- joint type of either wrought copper or cast brass. Adapters for connection to threaded valves, fittings, meters and other equipment shall be cast brass. Recesses shall be smooth and correctly sized to provide proper clearance over the tubing. Solder shall be composition 95/5 tin-antimony or Brigit. Flux shall be noncorrosive. The solder shall contain no lead.
 2. Mechanical grooved joint pipe couplings may be used for connecting equipment to the piping system, headers, and distribution piping in lieu of soldered tube or fitting connections for water piping with NSF-61 rated temperatures to +180°F. System shall meet the low lead requirements of NSF-372.
 - a. Coupling housing clamps shall consist of two ductile iron castings complying with ASTM A-536, cast with offsetting angle-pattern bolt pads. Housing clamps shall hold in place an elastomer water sealing gasket of a FlushSeal® pressure responsive design. Clamps and gaskets shall be manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)
 - 1) Victaulic Style 607H ‘Quick-Vic’ installation ready coupling, for direct stab installation without field disassembly.
 - b. Fittings shall be manufactured to copper-tube dimensions, ASME B16.22 or ASME B16.18 Victaulic Copper-Connection.
 - c. Flange Adapter: Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components. For use with copper-tube dimensioned grooved ends. Victaulic Style 641.
 3. Victaulic Installation-Ready™ fittings for grooved end copper tubing shall be manufactured to copper-tube dimensions. Fittings shall be ductile iron conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, complete with PVDF (Poly Vinylidene Fluoride) and Grade “EHP” EPDM-HP [Grade ‘T’ Nitrile] gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be rated to 300 psi (2065 kPa) with Type K or L Copper Tubing.
 4. Viega ProPress Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have SC (Smart Connect) feature design (leakage path). Smart Connect™ (SC Feature) In ProPress ½” to 4” dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an unpressed connection (when testing from ½ to 85 psi). The function of this feature is to provide the installer

quick and easy identification of connections which have not been pressed prior to putting the system into operation.

- B. At contractor's option, branch piping serving toilet rooms and downstream of toilet room isolation valves, and piping serving individual fixtures may be PEX piping as specified for underground water piping.

2.4 UNDERGROUND SOIL, WASTE, VENT AND DRAIN PIPING:

- A. Underground soil, waste, vent and storm drainage piping shall be as follows (unless otherwise indicated on Drawings):
 - 1. Underground sanitary and storm drain lines shall be hub- and-spigot cast-iron, or plastic pipe.

2.5 ABOVEGROUND SOIL, WASTE, VENT AND DRAIN PIPING (includes condensate drain piping):

- A. Aboveground soil, waste, vent and storm drainage piping:
 - 1. Where exposed in rooms or where located in return air plenums, piping may be hub- and-spigot cast iron, or "No-Hub" cast iron, threaded galvanized steel, threaded copper nickel steel, threaded cast iron, copper tubing, or CPVC pipe. **PVC piping shall not be used where exposed or located in return air plenums.**
 - 2. Where installed inside walls or above ceilings that are not return air plenums, piping may be hub- and-spigot cast iron, or "No-Hub" cast iron, threaded galvanized steel, threaded copper nickel steel, threaded cast iron, copper tubing, PVC or CPVC pipe.
 - 3. Exposed waste piping and fittings in toilet rooms, and in finished areas, shall be chromium plated brass. Pipe shall be red brass, standard weight, iron pipe size and thickness, ASTM B-43, and fittings shall be threaded cast-brass of the recessed drainage pattern. Chromium plated piping shall be carefully measured and cut so that no more than one full turn of thread shall be exposed beyond any fittings. Joints between brass and ferrous pipes shall be threaded.

2.6 TRAPS:

- A. Provide deep seal traps on all floor drains.

2.7 CLEANOUTS AND FERRULES:

- A. Cleanouts shall be installed as shown on Drawings and where required by the building code.
- B. Cleanout plugs for threaded fittings shall be in accordance with Table 52 of CS 188. Except for test openings, where size must be sufficient to admit test plug, bushings will be permitted on pipes 5-inches and larger to reduce plug size to 4-inches; cleanout plugs for piping 4-inches and smaller shall be the same size as the pipe.

- C. Cleanout plugs for hub-and-spigot fittings shall be screwed into ferrules caulked into the fitting. Ferrules and plugs shall be in accordance with Table 54 of CS 188.
- D. Cleanout plugs on copper drainage lines shall be installed in solder-joint fittings having threaded openings provided for the cleanout, or in solder-joint fittings with threaded adapters.
- E. Acceptable Manufacturer - Josam, Smith, Zurn, Wade.

2.8 FLASHING:

- A. Openings in roof for waste vent pipes shall be provided with flexible rubber boots clamped to vent pipe and flashed into roofing. Products and installation shall be watertight and shall be approved by the National Roofing Contractor's Association.

2.9 DIELECTRIC ISOLATORS:

- A. Provide a dielectric isolator at all points of connection between ferrous and nonferrous piping. Isolators shall be made of Teflon or nylon made up in the form of screwed type unions or insulating gaskets and bolt sleeves and washers for standard flanged connection.
- B. Connections may be made with Schedule 80 CPVC nipples, nylon or Teflon bushings selected for the temperatures and pressures of the system.

2.10 VALVES:

- A. All valves shall be designed for 125 psi minimum water working pressure, but in no case less than 150% of the system operating pressure, whichever is greater.
- B. Provide valves with extended necks in insulated piping.
- C. All valves installed in potable systems shall be lead-free in accordance with Federal Government S.3874.
- D. Ball Valves:
 - 1. For size 4- inch and smaller shall be 2 piece, full port brass ball valves with RPTFE seats and packing, blow out proof stem, and sweated or threaded ends.
 - a. Equivalent to Apollo 77FLF.
- E. Check Valves:
 - 1. Check valves 2-inch in size and smaller shall be soldered bronze body, horizontal swing check type with regrindable seat and Buna-N disc.
 - a. Equivalent to Nibco S-413.

2. Check valves 2 1/2-inch in size and larger shall be flanged, cast iron, spring actuated, horizontal swing check type with stainless steel spring, aluminum bronze bushing, Buna-N bonded to bronze seat, and bronze disc.

- a. Equivalent to Nibco F-910-B-LF.

F. Butterfly Valves:

1. 2 through 6-inch, 300 psi (2065 kPa) maximum pressure rating, with copper tubing sized grooved ends. Cast brass body to UNS C87850. Aluminum bronze disc to UNS C95500, with pressure responsive elastomer seat. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Certified to the low lead requirements of NSF-372. Victaulic Series 608N.

G. Acceptable Manufacturers – Apollo, DeZurik, Milwaukee, Nibco, Victaulic, Watts.

H. Automatic Balancing Valves:

1. Automatic flow control valves shall be factory set to a rated flow, and shall automatically control the flow to within $\pm 10\%$ of the rated value over a 40 to 1 differential pressure, operating range, (2 to 80 psid). Valves shall have the capabilities and pressure ratings as indicated and conform to this specification.
2. Automatic balance assembly shall include one or more precision sculptured brass or polyphenylsulfone orifices with an elastomeric diaphragm. Each automatic balancing valve shall automatically control the flow rate to within $\pm 10\%$ of its rated flow, over a temperature range of 32 to 225°F, and a pressure differential range of 2 to 80 psid.
3. Inline copper sweat valves 1/2, 3/4, 1, & 1 1/4 inch shall consist of a wrought copper (ASTM B88-83a) housing. Valve bodies shall be suitable for 522 psig working pressure rating per ASME B31.9 Building Services Piping. Flow rates from 0.5 to 25 gpm shall have a differential pressure operating range of 2 to 80 psid.
4. Equivalent to Hays Model 2511, or Victaulic ICSS TA Series 76X.

2.11 WALL HYDRANTS:

- A. Wall hydrants shall be cast bronze, chrome plated nonfreeze type with 3/4-inch inlet and 1-inch copper casing of sufficient length to extend through walls as required to place valve inside the building. Valve rod and seat washer shall be removable through the face of the hydrant. Hydrants shall be furnished complete with adjustment locknuts, union elbows, detachable T-handles, and integral vacuum breaker.
- B. Acceptable Manufacturers - Josam, MiFab, Prier, Smith, Wade, Watts, Woodford, Zurn.

2.12 GAS PIPING:

- A. Underground distribution piping shall be polyethylene piping conforming to applicable State and Federal Standards. The installation shall be completed by personnel meeting the requirements of applicable State and Federal Standards. Risers to above grade shall be anodeless. Joints shall be fusion butt welded. Provide tracer wire.

- B. Aboveground distribution piping 2-inches and smaller shall be Schedule 40 black steel using malleable iron threaded fittings, wrought steel butt welding fittings or pressed fittings.
1. Pressed fittings shall be Viega MegaPress Gas Press Fittings. MegaPress Fittings: ½-inch through 2-inch shall conform to ASME B31.1, ASME B31.3, or ASME B31.9 MegaPress fittings with zinc and nickel coating for use with IPS carbon steel pipe conforming to ASTM A53, ASTM A106, ASTM A135, or ASTM A795. MegaPress fittings shall have an HNBR sealing element, 420 stainless steel grip ring, separator ring, and an un-pressed fitting leak identification feature. Sealing elements shall be verified for the intended use. Installation must be in accordance to manufacturer's instructions and specifications.
- C. Aboveground distribution piping 2 1/2-inches and larger, and concealed piping of any size shall be Schedule 40 black steel with wrought steel butt welding fittings, or pressed fittings as specified above.
- D. Valves:
1. For sizes 1-inch and smaller, provide ball valves, 125 psig WOG.
 2. For sizes larger than 1-inch, provide gas cocks, 125 psi WOG, bronze straight way cocks, flat or square head, threaded ends for 2-inches and smaller, flanged ends for 2 1/2-inches and larger.

2.13 GAS PRESSURE REGULATORS:

- A. Regulators shall be single stage, steel jacketed, corrosion resistant, with vent line extended to atmosphere, threaded ends for 2-inches and smaller, flanged ends for 2 1/2-inches and larger.
- B. Acceptable Manufacturers - Fischer, Maxitrol.

2.14 FIXTURE SUPPLY PIPING SUPPORTS:

- A. Support and position fixture rough-in piping in plumbing chases, shafts, fixture walls or batteries, at each fixture with metal strut framing system or angle iron supports and U- bolt clamps or high impact polystyrene or ABS anchoring channels designed for the purpose. Anchors shall effect positive electrolytic isolation, noise dampening, solid support, and rough-in positioning. See Section 23 20 00 for additional requirements.
- B. Acceptable Manufacturers - Sumner, Pipefix, Channel.

2.15 BACK-TO-BACK FIXTURE MANIFOLD:

- A. Wherever fixtures utilizing both hot and cold water are installed back-to-back on a partition, the hot water shall be on the left and the cold water shall be on the right on both sides of the partition. Cast bronze manifold fittings designed for the purpose, and to offset around stack may be used.
- B. Acceptable Manufacturers - Precision Plumbing Products "BAC 2 BAC", or approved equal.

2.16 SHOCK ABSORBER:

- A. Shock absorbers shall be factory fabricated stainless steel casing and bellows with working pressure of 250 psi, bellows precharged with nitrogen. Construction shall be in accordance with Plumbing and Drainage Institute Standard PDI-WH201, ANSI A-11, 2.26.1, and ASSE 1010.
- B. Acceptable Manufacturers - Josam, MiFab, Smith, Wade, Watts, Zurn.

2.17 PLUMBING FIXTURES, GENERAL:

- A. Provide plumbing fixtures scheduled, at locations and mounting heights indicated on architectural drawings.
- B. Provide fixture, trim and equipment specified or of similar quality, design, capacity, appearance and function by acceptable manufacturer listed.
- C. Provide required trim for each fixture including faucets, stops, drains, tail pieces, traps and escutcheons.
- D. Fixtures fitted to walls shall have backs ground square and true. Caulk juncture of fixture with wall or floor as directed by the Architect.
- E. Exposed Pipe - Exposed flush, waste and supply pipes at fixtures shall be chromium plated brass pipe, iron pipe size.
- F. Vandalproofing - Provide vandalproof fittings for all fixtures.
- G. Acceptable Manufacturers -
 - 1. Fixtures - American Standard, Crane, Gerber, Kohler, Sloan, Toto, Zurn.
 - 2. Stainless Steel Sinks (self-rimming) - Elkay, Just, Kohler, Kindred.
 - 3. Faucets and Drains - American Standard, Bradley, Chicago, Delta, Eljer, Elkay, Gerber, Kohler, Powers, Sloan, Speakman, Symmons, Zurn.
 - 4. Supplies, Stops and Traps - Central, Crane, Dearborn, Eljer, McGuire.
 - 5. Closet Seats - Church, Beneke, Olsonite, Sperzel.
 - 6. Carriers - Josam, MiFab, Smith, Wade, Watts, Zurn.
 - 7. Service Sinks - Florestone, Fiat, Stern-Williams.
 - 8. Floor Drains - Josam, MiFab, Smith, Wade, Watts, Zurn.

2.18 PIPE HANGERS AND SUPPORTS:

- A. See Section 23 01 00.

2.19 WATER HEATER - ELECTRIC STORAGE TYPE:

- A. Provide storage water heater as scheduled, with welded steel tank, adjustable thermostat, fiberglass or polyurethane closed cell insulation and protective sheet metal jacket with baked

enamel finish, replaceable magnesium anode rods, temperature and pressure relief valve, and packaged controls.

- B. The tank shall be fully glass or phenolic epoxy plastic lined. The tank shall be approved for a working pressure of 150 psi. A hand hole cleanout and a drain valve shall be located near the bottom of the tank. The tank and heating elements shall be covered by a three year limited warranty against failure due to corrosion, metal failure, or over-heating caused by buildup of sand, sediment or sludge.
- C. Provide a thermometer and well at the outlet of water heater.
- D. Acceptable Manufacturers - A.O. Smith, Lochinvar, PVI, Rheem, Ruud, State.

2.20 TEMPERATURE AND PRESSURE RELIEF VALVES:

- A. Provide combination temperature and pressure relief valves on each domestic water heater and fired pressure vessel. Valves shall be constructed and rated in accordance with ASME standards, with cast iron bodies, shall be of the diaphragm type, with stainless steel spring, field adjustable, set to relieve above the operating pressure or temperature, but lower than the design pressure of the vessel. Pipe blowoff line full size to 6" above finished floor.
- B. Acceptable Manufacturers - Amtrol, Bell & Gossett, Taco, Watts.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION:

- A. Do not route piping above electrical distribution equipment, per National Electric Code.

3.2 SOIL, WASTE AND VENT SYSTEMS:

- A. Pitch lines at 1/8-inch per foot minimum and 1/4-inch per foot where possible.
- B. Below Grade - Install immediately after excavation, lay pipe so that entire length bears on firm soil, excavate for hubs, do not backfill until installation has been observed.
- C. Above Grade - Install in structure as high as possible. Independently support each length of cast iron. Support steel pipe according to hanger schedule. Support vertical lines at each floor, both horizontally and laterally.
- D. Joints and Fittings for CPVC and PVC plastic piping shall be prepared and solvent welded according to manufacturer's recommendations.
- E. Vents - Slope up to high point. Support each length of vent pipe independently within structure.
- F. Sanitary Waste Cleanouts - Install cleanouts where required by code and as shown on Drawings. Set floor cleanout covers flush with adjacent finished surface.

- G. Floor Drains, Waste Receptors - Install as shown and connect to cast-iron, deep seal "P" trap. Where a water proof membrane is used, anchor membrane to flange with clamping collar and rustproof bolts.
- H. Drain Lines - Install drain lines from air conditioning equipment, tanks and other items of equipment requiring regular drainage, to waste receptors. Terminate above receptors with elbow turned down when piping is run horizontal to receptor.
- I. Plumbing Fixtures - Rough-in and install plumbing fixtures at height as recommended by the manufacturer unless otherwise indicated on architectural drawings. Caulk perimeter of wall or floor mounted fixture where it meets wall or floor. caulking shall be of type and color as selected by Architect.

3.3 DOMESTIC WATER SYSTEMS:

- A. Below Grade - Install immediately after excavation, do not backfill until installation has been observed, and lay pipe so that entire length bears of firm soil.
 - 1. Site Verification of Conditions:
 - a. Verify that site conditions are acceptable for installation of the PEX potable water system.
 - 2. PEX Piping Installation:
 - a. Do not proceed with installation of the PEX potable water system until unacceptable conditions are corrected.
 - b. Install PEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the 2006 Plastic Pipe Institute/Plastic Pipe and Fitting Association/NAHB/PATH Design Guide.
 - c. Joints below grade shall be limited to those required for tees and connection to valves at connections to buildings.
 - d. Minimum horizontal supports are to be installed not less than 32 inches between hangers in accordance with model plumbing codes and the installation handbook.
 - e. Do not expose PEX tubing to direct sunlight for more than 30 days.
 - f. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
 - g. Protect PEX tubing with sleeves where abrasion may occur.
 - h. Use tubing manufacturer supplied bend supports where bends are less than six times the outside pipe diameter.
 - i. Pressurize tubing with air in accordance with applicable codes or in the absence of applicable codes to a pressure of 25 psi (173 kPa) above normal working pressure of the system.
 - j. Comply with safety precautions when pressure testing, including use of compressed air, where applicable. Do not use water to pressurize the system if ambient air temperature has the possibility of dropping below 32 degrees F (0 degrees C).
 - k. Field Quality Control:

- 1) Manufacturer's Field Services: Provide manufacturer's field service consisting of product use recommendations and one site visit for inspection of product installation in accordance with manufacturer's instructions.
- B. Above Grade - Run level as high as possible in building structure, install hangers per schedule, allow for expansion and contraction, and anchor where required. Separate hot and cold pipes, with 6-inch minimum clear space between piping. Install 3/4-inch hose end drain valve at low points. Install ball valve at each plumbing fixture or group of fixtures, and at each point of connection to equipment. Allow access to equipment, for removal and servicing of pumps or equipment without draining system.
1. PEX Piping Installation:
 - a. Install PEX tubing in accordance with the tubing manufacturer's recommendations and as indicated in the 2006 Plastic Pipe Institute/Plastic Pipe and Fitting Association/NAHB/PATH Design Guide.
 - b. Exposed PEX piping shall be neatly installed plumb and parallel to building surfaces, and supported to eliminate sags and deflections.
 2. Copper Piping Installation:
 - a. For slabs on grade, copper pipe shall be separated from sand fill beneath poured concrete by a minimum of 6 inches of soil backfill.
 - b. Isolate copper pipe from concrete at all locations where piping penetrates concrete or masonry construction.
- C. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)
- D. Viega ProPress connections: Copper press fitting joints shall be made in accordance with the manufacturer's installation instructions. Pipe shall be approved by manufacturer for use with fittings. Piping shall be square cut, properly deburred, and cleaned. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.
- E. Connections to equipment:
1. Connect to each plumbing fixture.
 2. Connect to each hydrant.
 3. Provide valved connections to each piece of kitchen equipment or owner-provided equipment requiring water connection. Provide pressure regulators, pressure reducing valves, vacuum breakers, shock arrestors and other accessories as required for equipment supplied.

4. Provide unions or flanged connections at each piece of equipment connected.
5. Install supply connections to fixtures through wall as high under fixtures as possible.

3.4 WATER HEATER INSPECTION CERTIFICATE:

- A. When required by the Kansas Boiler Safety Act for the storage capacity and/or firing rate of the installed water heater, the Contractor shall be responsible for obtaining an inspection and acceptance certificate from the State Boiler Inspector. The Contractor shall schedule and pay for the inspection, and shall post the certificate(s) in the room containing the water heater.

3.5 SHOCK ABSORBERS:

- A. Install in accessible locations, see drawings. Provide access panels where required.

3.6 DISINFECTION OF WATER SYSTEMS:

- A. General - Disinfect all domestic water systems. Disinfection shall not start until water systems are complete, connections made, and system is flushed out. Upon completion of disinfection, submit certificate and certified bacteriological test report for approval.
- B. Follow the method prescribed by the local Health Department, Building Code Department or water purveyor. In the absence of a prescribed method, follow the procedure outlined in either AWWA C651 or AWWA C652.

3.7 GAS PIPING SYSTEM:

- A. Above Grade - Run level and as high as possible. Install hangers per schedule. Allow for expansion and contraction. Anchor where required. Install Schedule 10 carbon steel welded gas tight pipe casing around piping in concealed vented areas. Pipe casings to be vented to atmosphere. Pipe casings not required in exposed areas.
- B. Below Grade - Installation shall meet the requirements of applicable State and Federal Standards.
- C. Above Roof - Support piping at no more than 8 feet on center, with manufactured pipe supports: Miro Industries Model 3-R or approved equivalent. The pipe supports shall be a roller-bearing type designed to support piping or conduit, and to absorb thermal expansion and contraction of piping or conduit thus preventing damage to roof membrane. The pipe or conduit shall rest on a polycarbonate resin roller and a glass-filled nylon rod situated in a polycarbonate resin seat.
- D. Connections to equipment - Connect at each appliance or gas using device and provide gas cock unions, and dirt leg.

3.8 TESTING:

- A. Systems shall be tested in accordance with the 2012 International Plumbing Code prior to insulating, covering or concealing this work.
- B. Plug or cap lines for testing and disconnect equipment and devices which may be damaged by excessive test pressures.
- C. Before final connections are made to site sewer and connection of fixtures, all underground drainage piping shall be hydrostatically tested. All openings shall be capped or plugged and the system filled with water to the top of a vertical section of pipe 10 feet high, temporarily connected to the highest point of the underground system. The water shall be allowed to stand in the system for at least 30 minutes prior to inspection. If the water level remains constant and no leaks are found during the period of inspection, the water shall be drained from the system. Final connections shall then be made to the site sewer and the trenches backfilled.
- D. Before any fixtures are connected, all sanitary drain and vent systems, and storm drainage systems above ground, shall be hydrostatically tested. All opening shall be capped or plugged and the systems filled with water. The water shall be allowed to stand in the systems for at least 30 minutes prior to inspection. If the water level remains constant and no leaks are found during the period of inspection, the water shall be drawn off and fixtures, etc., connected. No parts of a system shall be tested with less than 10-foot head of water. No parts of a system using cast iron bell-and-spigot pipe shall be tested with more than a 40-foot head of water, and no parts of a system using screwed piping shall be tested with more than 200-foot head of water. The Contractor shall be responsible for determining the amount of piping he wishes to test at one time, but the above conditions shall not be exceeded.
- E. Before final connections are made to a water supply system, all underground water piping shall be hydrostatically tested and proven tight at a pressure of not less than 100 psi or 50 psi in excess of the working pressure, whichever is greater, at the lowest point in the system. The pressure shall be maintained for at least 1 hour for inspection, the water shall be drained from the system. Final connections shall then be made to the water supply system, and the trenches backfilled.
- F. Before any fixtures or equipment are connected, all domestic water and compressed air systems connected thereto above ground shall be hydrostatically tested and proven tight at a pressure of not less than 100 psi or 50 psi in excess of the working pressure, whichever is greater, at the lowest point in the system. The pressure shall be maintained for at least 2 hours for inspection. If the pressure remains constant and no leaks are found during the period of inspection, the water shall be drained from the systems and final connections shall then be made to the fixtures, etc.
- G. All tests shall be made when there is no danger of freezing, prior to enclosure of any parts of the systems by furrings, suspended ceilings, etc.
- H. Test to demonstrate the capacities and general operating characteristics of all equipment, such as water heating outfits, pumps, water coolers, etc., shall be made under the direction of the Architect at the time of final inspection and under conditions imposed by him. Water heaters having steam or water coils shall be tested with the main heating system in operation.
- I. Gas piping shall be tested in accordance with the requirements of the local building code and the 2012 International Fuel Gas Code.

- J. All tests shall be made in the presence of and results approved by the Architect.
- K. Should any leaks, flaws, or defective materials or equipment be found during the testing operations, such leaks or flaws shall be corrected, and defective materials and equipment replaced. All defective joints shall be remade, and calking or threaded joints will not be acceptable. After corrections have been made, tests shall be repeated until all systems are proven tight and satisfactory. All corrections and retests shall be made at Contractor's expense.

3.9 CLEANING:

- A. See Section 23 01 00.

3.10 COMPLETION:

- A. Complete each piping system in its entirety. Properly support the system, clean the interior surfaces of the pipe by flushing, and disinfecting domestic water piping as specified. Leave systems filled and free from air, and ready for operation and testing.

END OF SECTION 22 00 00

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SECTION 23 01 00 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS:

- A. Work covered by this section of these specifications will be accomplished in accordance with the respective drawings, information, or instructions to bidders, general requirements, and the supplementary and general conditions of these specifications. Supplementary conditions, special conditions, addenda, or directive which may be issued by the Engineer shall be complied with.
- B. Bidders shall determine the contents of a complete set of drawings and specifications and be aware that they may be bidding from a partial set of drawings, applicable only to the various separate contracts, sub-contracts, or trades as may be issued for bidding purposes only. The contract documents are combined Architectural, Structural, Plumbing, Heating, Ventilating, and Air Conditioning and Electrical Drawings and Specifications. Drawings and Specifications are on file in the Engineer's office and each Bidder shall thoroughly acquaint himself with the details of the complete set of drawings and specifications before submitting his bid. Drawings and specifications form a part of the contract documents for each separate contract and shall be considered as bound therewith in the event partial sets of plans and specifications are issued for bidding only. The submission of bids shall be deemed evidence of the review and examination of drawings, specifications, and addenda issued for this project as no allowance will be made because of the Contractor's unfamiliarity with any portion of the complete set of documents.
- C. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.
- D. Existing remaining systems shall be left in perfect working order upon completion of all new work.
- E. Any equipment which is removed and not reinstalled shall be delivered on site to the Owner, or removed by the Contractor, as directed by the Owner.

1.2 MECHANICAL CONTRACTOR QUALIFICATIONS:

- A. Mechanical Contractor (as a company) and his job superintendent for their portion of the work shall have at least three years of satisfactory experience in completion of projects of comparable size and complexity. Evidence of this experience will be required before approval of the Engineer as being acceptable for their portion of the work.

1.3 SCHEDULE:

- A. The schedule and sequence of work must be carefully coordinated with the Owner, to ensure that all work performed within the existing buildings will result in a minimal amount of noise, dust and disruption to the activities in the existing buildings.

- B. All interruptions of existing services must be coordinated with the Owner, to minimize inconvenience and disruption to the activities in the existing buildings. All interrupted services shall be restored as quickly as possible. All interrupted systems shall be thoroughly cleaned and tested prior to being placed back into operation.

1.4 SCOPE:

- A. The work included under this specification consists of the furnishing of all labor, materials, tools, transportation, services, etc., which are applicable and necessary to complete the installation of the systems specified in these specifications, as illustrated on the accompanying drawings, or as directed by the Engineer.
- B. In general, the various lines and ducts to be installed by the various trades under this specification shall be run as indicated, as specified herein, as required by particular conditions at the site, and as required to conform to the generally accepted standards so as to complete the work in a neat, quiet, and satisfactorily workable manner. Run work parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The construction details of the building are illustrated on the Drawings. Each Contractor shall thoroughly acquaint himself with the details before submitting his bid as no allowance will be made because of the Contractor's unfamiliarity with these details. Place inserts to accommodate the ultimate installation of the pipe hangers in the forms before construction. Concealed lines shall be installed as required by the pace of the general construction to precede that general construction.

1.5 INSPECTION OF SITE:

- A. Contractor shall visit the site, verify existing items shown on plans or specified, and familiarize himself with the working conditions, hazards, existing grades, actual formations, soil conditions, and local requirements involved, and submission of bids shall be deemed evidence of such visit. Proposals shall take these existing conditions into consideration and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.

1.6 UTILITIES, LOCATIONS AND ELEVATIONS:

- A. Locations and elevations of the various utilities included within the scope of this work have been obtained from Record Drawings and other substantially reliable sources and are offered separately from the Contract Documents as a general guide only, without guarantee as to accuracy. Contractor shall examine the site, availability of utilities as to their relation to the work; the submission of bids shall be deemed evidence thereof.

1.7 CODES AND STANDARDS:

- A. Workmanship, material and equipment shall be in accordance with Specifications and drawings and in some instances the requirements exceed those required by codes and standards. Where not exceeded, the codes and standards shall be considered as absolute minimum requirements.

1.8 MATERIALS AND WORKMANSHIP:

- A. Materials unless otherwise specified shall be new, free from any defects, and of the best quality of the respective kinds. Like materials used shall be of the same manufacture, model, and quality unless otherwise specified.
- B. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, adjusted, and conditioned as recommended by the manufacturers, or as indicated in their published literature, unless specifically herein specified to the contrary.
- C. Work under this contract shall be performed by competent workmen and executed in a neat and workmanlike manner providing a thorough and complete installation. Work shall be properly protected during construction, including the shielding of soft or fragile materials, and the temporary plugging of open lines during construction. At completion, the installation shall be thoroughly cleaned and tools, equipment, obstructions, or debris present as a result of this contract shall be removed from the premises.

1.9 COOPERATION:

- A. Work under these specifications shall be accomplished in conjunction with other trades on this project in a manner which will allow each trade adequate time at the proper stage of construction to fulfill his work.
- B. Maintaining contact and being familiar with the progress of the general construction and timely installation shall be the responsibility of this trade to expedite this contract and avoid unnecessary delays in the progress of other trades.
- C. Should any question arise between trades as to the placing of lines, ducts, conduits, fixtures, or equipment, or should it appear desirable to remove any general construction which would affect the appearance or strength of the structure, reference shall be made to the Engineer for instructions.

1.10 DRAWINGS AND SPECIFICATIONS:

- A. The drawings show diagrammatically the locations of the various lines, ducts, conduits, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building, and in cooperation with other trades and, in all cases, shall be subject to the approval of the Engineer. The Engineer reserves the right to make any reasonable change in the location of any part of this work without additional cost to the Owner.
- B. Should any deviations from the contract documents be deemed necessary by the Contractor, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Engineer for approval.

- C. Exceptions and inconsistencies in plans and specifications shall be brought to the Engineer's attention before bids are submitted; otherwise, the Contractor shall be responsible for the cost of any changes and additions that may be necessary to accommodate his particular apparatus.
- D. Contractor shall lay out his work maintaining lines, grades, and dimensions according to these drawings with due consideration for other trades and verify dimensions at the site prior to any fabrication or installation; and should any conflict develop or installation be impractical, the Engineer shall be notified before any installation or fabrication and the existing conditions shall be investigated and proper changes effected without any additional cost.
- E. Manufactured equipment shown, arrangement of parts, openings in floors, roof or walls are sized for a particular manufacturer's equipment. The Contractor shall verify exact sizes and arrangements required by equipment and in submitting his equipment for approval he certifies that the equipment will fit within the space allotted for it.
- F. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of materials or work. The Engineer does not assume any responsibility either direct or implied, for omissions or duplications by the Contractor and any Sub- Contractor due to real or alleged error in the arrangement of matter in the Contract Documents.

1.11 ENGINEER'S APPROVAL:

- A. In any statement under this Contract where "approval" is required or requested, it is understood that such approval must be obtained from the Engineer in writing before proceeding with the proposal, and an adequate number of copies of such proposal shall be submitted to the Engineer.
- B. The approval by the Engineer of any materials, changes, drawings, etc., submitted by the Contractor will be considered as general only and to aid the Contractor in expediting his work. Such approval as may be given does not in any way relieve the Contractor from the necessity of furnishing the material and performing work as required by the drawings and specifications.

1.12 LOCAL RESTRICTIONS:

- A. Contractor shall become familiar with rules and regulations of the City, County, and State; or any other authority having jurisdiction over this project; and if, in his opinion, any work or materials shown on the drawings or specified do not comply with these rules and regulations as to size, type, capacity, and quality, he should make it known prior to the submission of his bid, which shall be deemed evidence of compliance; otherwise, the Contractor shall be responsible for the approval of work or material; and, in the event that any such authority should indicate disapproval, he shall correct same with materials approved by the Engineer at no additional cost to the Owner

1.13 ELECTRIC WIRING:

- A. The Mechanical Contractor shall erect motors in place ready for power connection and where scheduled or indicated on plans, shall furnish with each such motor a starter of the type specified and deliver it in good condition to the Electrical Contractor for installation. The

Electrical Contractor shall mount such starters as directed, furnishing supporting structure where necessary. Those who furnish motors and equipment shall also furnish with each item necessary instructions and wiring diagrams to the Electrical Contractor. Refer to Electrical Sections of the Specifications to determine in further detail the scope of the electrical work.

- B. Equipment actually installed on the project generally differs slightly from the equipment specified. To avoid incompatible branch service, prepare a list of electrical consuming items being installed in the project under this contract, which lists volts, phase, service factor, etc., of each and every piece of equipment or electrical device. Formally transmit the list to the Electrical Contractor to verify the compatibility of the electric service provided to each item. This coordination shall be completed prior to finalizing equipment and material purchases for the project.
- C. If the Contractor furnishes motors differing in size from those scheduled, he shall notify the Electrical Contractor and make provisions for revised electrical and pay for any changes necessary.

1.14 RESPONSIBILITY:

- A. Contractor shall be held responsible for the satisfactory and complete execution of work included. He shall produce complete finished operating systems and provide incidental items required as part of his work, regardless of whether such item is particularly specified or indicated.

1.15 GUARANTEE:

- A. Contractor shall furnish a written guarantee in triplicate warranting all materials, equipment, and labor furnished by him to be free of all defects, for a period of one year from date of final acceptance by the Owner. He shall further guarantee that all equipment shall meet the characteristics, capacities, and workmanship specified; and should any defects or non-performance of equipment be indicated within the warranty period, the defects and/or equipment will be repaired or made good without cost to the Owner.

1.16 REFERENCE ABBREVIATIONS:

- A. References are made in the various mechanical sections to technical societies, codes, specifications, trade organizations, and regulatory authorities in accordance with the following abbreviations:
 - 1. AABC - Associated Air Balance Council
 - 2. AFE- Air Filter Institute
 - 3. AGA- American Gas Association
 - 4. AMCA- Air Moving and Conditioning Association
 - 5. ANSI- American National Standards Institute
 - 6. ARI- Air Conditioning and Refrigeration Institute
 - 7. ASHRAE- Society of Heating, Refrigeration and Air Conditioning Engineers
 - 8. ASME- American Society of Mechanical Engineers
 - 9. ASTM- American Society for Testing and Materials

10. AWSC- American Welding Society Code
11. AWWA- American Water Works Association
12. CISPI- Cast Iron Soil Pipe Institute
13. CTI- Cooling Tower Institute
14. FM- Factory Mutual
15. FS- Federal Specification
16. IRI- Industrial Risk Insurers
17. ISO- Insurance Services Organization
18. NAFM- National Association of Fan Manufacturers
19. NCPWB(MCAA)- National Certified Pipe Welders Bureau (Mechanical Contractors Association of America)
20. NFC- National Fire Codes
21. NFPA- National Fire Protection Association
22. PDI- Plumbing and Drainage Institute
23. SBI- Steel Boiler Institute
24. SMACNA- Sheet Metal and Air Conditioning Contractors National Association
25. UL- Underwriters Laboratories, Inc.

1.17 SHOP DRAWINGS AND DATA TO BE SUBMITTED:

A. SUBMITTALS WHICH DO NOT MEET THE FOLLOWING REQUIREMENTS WILL BE IMMEDIATELY REJECTED WITHOUT FURTHER REVIEW!!!

1. Catalog cutsheets and brochures will be preceded by a neatly arranged cover sheet having ample room for shop drawing stamps and bearing the following information in a prominent, immediately visible location and size:
 - a. Equipment name or number as referenced in the contract Documents (example: "AHU-A" or "Type A" light fixture).
 - b. All options or accessories provided.
 - c. Applicable Specification section and paragraph numbers.
2. Substitutions -
 - a. Cross reference individual manufacturer and catalog numbers of substitute products to those of specified material.
 - b. Prior to requesting permission to use substitute or alternate products, the Contractor shall investigate and make certain that the product-
 - 1) Conforms with the standard of performance and quality specified.
 - 2) Will physically fit in the space allocated, with sufficient access and maintenance space.
 - 3) Involves no additional costs to the Owner or extended construction time.
 - c. Should the use of a substitute product entail any changes in details or construction, the changes and information documenting the complete coordination with all affected trades shall be submitted prior to approval of substitution.
 - d. Provide with requests for permission to use substitute or alternate products, drawings, specifications, samples, performance data and other information as may

be required to assist in determination of acceptability of the product. The burden of proof is the Contractor's responsibility.

3. All similar or related items shall be submitted together under one cover sheet (i.e. fixtures, insulation, valves, equipment). Do not piece-meal submittals!!!

B. Equipment Items:

1. Submit manufacturer's certified data relative to equipment required for the installation of the HVAC, plumbing and fire protection systems.
2. Submit adequate engineering data on each piece of equipment to allow a careful check of compliance with the technical requirements of the Contract Documents. Clearly indicate on submittal data the manufacturer's name, piece number, equipment capacity, and other applicable technical data.
3. Submit the following data for Mechanical Systems-
 - a. Foundations, Supports, Hangers, Inserts.
 - b. Insulation.
 - c. Ventilation and Air Conditioning Equipment, Specialties and their Control Systems.
 - d. Plumbing Equipment, Piping, Fittings and Valves
 - e. Special Products Furnished by Mechanical Trades.
 - f. Openings, Special Framing and Access Doors.
 - g. Data for Testing and Balancing of the Heating, Air Conditioning and Ventilating Systems.
 - h. Installation Instructions - Submit Manufacturer's Printed Installation Instructions.
 - i. Temperature Controls.
 - j. HVAC Piping, Fittings and Valves
 - k. Air Devices.

1.18 INSTRUCTIONS:

- A. The Contractor shall furnish the services of competent instructors who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the equipment in each mechanical system. Each instructor shall be thoroughly familiar with all parts of the installation.
- B. The Contractor shall be responsible for videotaping all training sessions and shall submit two copies of the training videos on DVD discs.
- C. The number and length of training sessions shall be as specified in the various Sections of the Specification.
- D. These requirements are supplemented by requirements for specific equipment or systems in the various Sections of the Specification.

1.19 OPERATING AND MAINTENANCE MANUALS:

- A. Bind in looseleaf binders with the words, "Operating and Maintenance Manual" and the Project identification imprinted on the cover. Prepare four complete sets of records for the Owner, with table of contents, index, and tabbed Section dividers.
- B. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals-
 - 1. Copies or warranties and guarantees on each piece of equipment installed.
 - 2. Fixture brochures.
 - 3. Wiring and Control Diagrams.
 - 4. Approved Shop Drawings.
 - 5. Operating instructions for-
 - a. HVAC Systems.
 - b. Temperature Controls.
 - 6. Recommended maintenance procedures.
 - 7. Lists of major items of equipment with name, address, and telephone number of each local representative.
- C. Submit the manuals for approval at approximately 75 percent job completion.
- D. Each manual shall consist of-
 - 1. Complete description of each item of equipment and apparatus furnished and installed - including ratings, capacities, and characteristics.
 - 2. Fully detailed parts list, including all numbered parts of each item of equipment and apparatus furnished and installed.
 - 3. Manufacturer's printed instructions describing operation, servicing, maintenance and repair of each item of equipment and apparatus.
 - 4. Typewritten record of all tests made of materials, equipment, and systems. All such records shall state the date tests were conducted, the names of all persons making and witnessing the tests, and citing any unusual conditions relevant to the tests.

1.20 RECORD DRAWINGS:

- A. Accumulate Record Drawings during the construction of the Project. Keep one set of blue-line Contract Drawings at the job site at all times, and mark changes, rerouting or modifications which occur, clearly on the Drawings with dimensions.
- B. At completion of the job, deliver Record Drawings to the Engineer. Record Drawings shall be submitted for approval prior to final payment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer's names and catalog numbers are scheduled or specified for the purpose of establishing standard of design, quality, appearance, performance and serviceability, and not to limit competition. Scheduled products (as may be modified by detailed specifications) are those selected as the basis for system design with respect to physical size and space arrangements, required capacity and performance characteristics, and the product quality intended.
- B. The Drawings indicate specified products physically arranged in the spaces, as cataloged by specific manufacturers, generally as listed in the Equipment Schedules.
- C. Listed "Acceptable Manufacturer's" are those considered capable of manufacturing products conforming to detailed Specifications, and as such, are invited to compete on an equal basis provided the offering is comparable in every respect to scheduled or specified products and actually conforms to the detailed Specifications and Schedule requirements. Listing herein as "acceptable manufacturers" does not imply "accepted", "approved", or "prior approval", or any other such connotation. All product offerings must be submitted for approval after Contract award.
- D. Vendors are invited to submit material or equipment bids to bidding Contractors on any comparable equivalent product, whether or not the manufacturer of such product is listed herein as an "acceptable manufacturer". Such product bids should clearly indicate offerings that are not listed as "acceptable manufacturers". In the event a bidding Contractor, after satisfying himself that such unlisted product is in fact "equal" to the specified product with respect to design, quality, performance and arrangement (space requirements), and the Contractor desires to furnish that product on the Project, he may request the name of the manufacturer be added to the list of acceptable manufacturers by addendum prior to bid time.
- E. At a bidder's request, an unnamed manufacturer's equipment will be considered to determine additional "acceptable manufacturers" if a request is made in writing no later than ten days prior to the bid opening. If such requests are found acceptable, an addendum will be written listing additional acceptable manufacturers. Consideration will be given only to requests of bona fide bidders (Contractors), not to those received from vendors.
- F. Manufacturers of materials and equipment shall be as specified, scheduled, or as listed in each respective product Specification Article.

2.2 FLAME SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS:

- A. Materials and adhesives used throughout the mechanical systems for insulation, acoustical lining, filters, ducts, flexible connections, and jackets or coverings regardless of kind, or for piping or conduit system components, shall have a flame spread rating not over 25 without evidence of continued combustion and with a smoke developed rating not higher than 50. If such materials are to be applied with adhesives, they shall be tested as applied with such adhesives, or the adhesives used shall have a flame spread rating not over 25 and a smoke developed rating not higher than 50. (Note: materials need not meet these requirements where they are entirely located outside of a building and do not penetrate a wall or roof, and do not create an exposure hazard or where specifically exempted in the body of these Specifications).
- B. "Flame Spread Rating" and "Smoke Developed Rating" shall be as determined by the "Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 255, ASTM E84,

Underwriters Laboratories, Inc., Standard". Such materials are listed in the Underwriters Laboratories, Inc. "Building Materials List" under the heading "Hazard Classification (Fire)".

2.3 IDENTIFICATION OF PIPING, AND EQUIPMENT

- A. Identify mechanical equipment in main mechanical room only with nameplate bearing equipment name, number, module, and room(s) served (use room numbers on architectural plans), using bevel edges, 1/16-inch thick, 1 1/2- inch white laminated Bakelite with engraved black letters, 1/2-inch (double line) or 7/8-inch (single line) high, permanently mounted on the equipment in a conspicuous place with screws.
- B. Markings - Identify each piping system in main mechanical room and immediately inside tunnel access doors with the direction of flow (where applicable) indicated by legends and flow arrows. The markings shall be applied after all cleaning of the piping and insulation is completed. Identify with semi rigid mechanically applied plastic marked bands with background color coded per ANSI A13.1. Color of lettering and flow arrow shall be black. Marker material shall completely encircle the pipe when smaller than 8-inch ips.
1. Provide 1/2-inch letters, 8-inch long color field on outside diameters less than 1 1/2-inch.
 2. Provide 3/4-inch letters, 8-inch long color field on outside diameters of 1 1/2 to 2-inch.
 3. Provide 1 1/4-inch letters, 12-inch long color field on outside diameters over 2-inch, but smaller than 8-inch.
 4. Provide 2 1/2-inch letters, 24-inch long color field on outside diameters of 8-inch to 10-inch.
 5. Provide 3 1/2-inch letters, 36-inch long color field on outside diameters larger than 10-inch.
- C. The legend and flow arrow shall be applied at each valve location, and at each point where piping enters or leaves a wall, partition, bulkhead, cluster of piping or similar obstruction..
- D. Variations or changes in locations and spacing shall be made to meet conditions.
- E. Wherever two or more pipes run parallel, the printed legend and other markings shall be applied in the same relative locations so as to be in either vertical or horizontal linearity, whichever the case may be.
- F. The markings shall be located so as to be conspicuous and legible from any reasonable point.
- G. Standard pipe and conduit identification symbols.
1. CW - Domestic Cold Water.
 2. HW - Domestic Hot Water.
 3. THW - Tempered Domestic Hot Water.
 4. HWR - Domestic Hot Water Recirculation.
 5. SS - Sanitary Sewer.
 6. SV - Sanitary Vent.
 7. ST - Storm Drainage Piping
 8. GAS - Natural Gas.
 9. CHS – Chilled Water Supply.
 10. CHR – Chilled Water Return.

11. HS – Heating Water Supply.
12. HR – Heating Water Return.
13. REF – Refrigerant.
14. D - AC Condensate Drain.

H. Underground Warning Tapes for Buried Lines-

1. Provide 3-inch wide metallic core brightly colored polyethylene detection tape, shallow buried in the trench above nonmetallic pipes, serving the dual purpose of line location and identification. The tape shall be easily detected by any commonly used metal detector and shall bear a printed message (continuous along entire length) describing the contents of the line beneath.
2. Provide 6-inch wide brightly colored polyethylene tape, shallow buried in the trench above metallic pipes, to identify the contents of the line beneath. The tape shall bear a printed message (continuous along entire length) describing the type of the buried line and its contents.

I. Provide valve tags schedules and valve charts for each piping system consisting of Schematic Drawings of piping layouts along with a valve list, showing and identifying each valve by number, service, and location and describing its function. Upon completion of the Work, mount two copies of each chart, sealed to rigid backboard with clear lacquer, placed under glass and framed, on the wall. Two additional unmounted copies shall be delivered to the Owner.

J. Valve Tags - Provide 1 1/4-inch x 1 1/4-inch square laminated plastic name tags with 1/4-inch engraved letters for all valves, with black letters on white tags, marked for type of service intended. Attach tags to valve handles by "S" hooks.

K. Nameplates and tags shall correspond to the Record Drawings.

L. Submit complete details of identification legends, color fields, and sizes, coordinated between trades.

M. Acceptable Manufacturers - Seton Nameplate Corporation, W.H. Brady, Westline.

2.4 BEARINGS

A. All bearings supplied to the Project, regardless of supply responsibility or applications as integral parts of machinery, shall be standard catalog items and interchangeable with those of manufacturers currently represented in the local trade area with replacements stocked locally. Ball bearings shall be radial or thrust design, sealed and enclosed in a dust and moisture proof housing, and selected in accordance with AFBM Rating B-10 for at least 200,000 hour operating life as applied. Grease lubricated bearings shall be arranged for regreasing through alemite fittings located outside machinery enclosures in a convenient location, with grease relief fittings in the bearing housing to prevent overgreasing or seal rupture.

B. Acceptable Manufacturers - Andrews, Dodge, Fafnir, Hyatt, Link-Belt, MRC, McGill, New Departure, Sealmaster, SKF, Shafer, Rollway, Thompson, Timken, Torrington.

2.5 ELECTRIC MOTORS

- A. Shall conform to the requirements of IEEE, NEMA, and shall have voltage, phase, frequency and service as scheduled.
- B. Each item of motor driven equipment shall be furnished complete with the motors, drives and control equipment, including remote pilot devices as required to perform the specific function for which it is intended.
- C. Motors shall be sleeve or ball bearing type selected for quiet operation, shall be manufactured for general purpose duty, with each bearing accessible for lubrication, and designed for the load imposed by the drive.
- D. Motors 1/2 horsepower and larger shall have bearings with pressure grease lubrication.
- E. Motors connected to drive equipment by belt shall be furnished with adjustable slide rail bases except for fractional horsepower motors which shall have slotted bases. Motor leads shall be permanently identified and supplied with connectors.
- F. Provide open dripproof enclosures for motors located indoors in dry locations, and splashproof enclosures in wet locations. Motors to be installed outdoors shall be totally enclosed fan cooled.
- G. Unless otherwise scheduled, motors ½ horsepower and smaller shall be electronically commutated motors, designed for 120 volt, single phase, 60 Hz alternating current.
- H. Unless otherwise scheduled, motors larger than ½ horsepower shall be premium efficiency and shall meet the requirements for premium efficiency motors as defined in NEMA MG 1, latest edition. Minimum efficiencies and power factors shall not be less than listed in NEMA MG 1. The motor nameplate shall bear the designation "PREMIUM EFFICIENCY" as well as the efficiency and power factor.
- I. Unless otherwise scheduled, motors 1/2 horsepower and larger shall be squirrel cage induction type, for scheduled voltage, 3 phase, 60 Hz alternating current.
- J. Each motor shall be free from magnetic hum, designed for quiet operation.
- K. Each motor shall be suitable for the brake horsepower of the driven unit, rated with 1.15 minimum service factor, with the temperature rise not to exceed NEMA standards and shall be capable of withstanding momentary overloads of 25 percent without injurious overheating.
- L. Electrical Specifications - Copper windings, winding insulation system NEMA Class B or better, wound for standard voltages. Motors shall conform to NEMA Design B as a minimum.
- M. Mechanical Specifications - Frame dimensions conform to NEMA standards for "T-Frame" motors. Frame construction of motors larger than NEMA frame 145T of cast-iron or extruded aluminum construction and those of NEMA frame size 145T and smaller may be fabricated steel type. Nameplates shall be stainless steel. Grease lubricated ball or roller bearings shall be supplied unless otherwise specified. On NEMA frame sizes 182T and larger make provisions for regreasing by use of removable grease plugs.
- N. Acceptable Manufacturers - Allis Chalmers, Baldor, Century, General Electric, Ideal, Lincoln, Louis Allis, Marathon, Reliance, U.S., Wagner, Westinghouse.

2.6 MOTOR STARTERS

- A. Except where otherwise specified or scheduled, each starter shall be furnished by the supplier who furnishes the equipment it controls.
- B. Provide a manual or magnetic starter for each motor. Where such devices are included in an "Equipment Control Schedule", they shall be as scheduled. Otherwise, they shall be as recommended by the equipment manufacturer.
- C. Magnetic starters shall include overload protection for each phase wired with normally closed contacts in series control circuit ahead of any other control contacts on the control side of the solenoid coil, and no contacts between the other side of the solenoid coil and the control power source. Motor starters shall conform to NEMA Standards for Industrial Control for 3 phase motors, No. 1C-1, with 120 volt (maximum) control circuit and control power transformer.
- D. Where individual starters and disconnect switches (or circuit breakers) are indicated to be in the same location, furnish combination devices in a common housing. Fused disconnects shall have rejection type fuse clips and Class RK-1 fuses.
- E. In every instance where magnetic starters are not required, furnish manual starters for fractional horsepower single phase motors - "ON-OFF", snap switch type with soldered ratchet overload protection.
- F. When interlocking or automatic control of single phase motors is indicated or required, the motors shall be furnished with magnetic across-the-line starters.
- G. When interlocking or automatic control of electric heaters is indicated or required, the heaters shall be furnished with contactors. Provide control power transformers as required to maintain control circuit voltages not exceeding 120 volts.
- H. Provide with each magnetic starter a reset button, pilot light, and HAND-OFF-AUTO switch, heavy duty type, mounted in starter cover. Provide field reversible (normally open or normally closed) auxiliary contacts required for interlocking but in no case less than two per starter.
- I. Acceptable Manufacturers - Allen Bradley, Cerus, Cutler-Hammer, General Electric, I-T-E, Square D, Westinghouse.

2.7 ACCESS DOORS:

- A. Furnish, for installation under appropriate Section of the Work, access doors at each point required to provide access to concealed valves, dampers, damper operators, and other devices requiring operation, adjustment, or maintenance.
- B. Shall be 16 gage steel, with mounting straps, concealed hangers, and screwdriver locks, designed for the doors to open 180 degrees, minimum.
- C. Access doors installed in fire walls or partitions shall be UL labeled to maintain surfaces.
- D. Provide prime coat finish for installation in ceilings or painted or unfinished surfaces.

- E. Provide polish chrome plate finish for installation in unpainted finished walls.
- F. Acceptable Manufacturers - Baldwin, Hannon, Josam, Miami, Carey, Milcor, Titus, Wade, Walsh, Zurn.

2.8 METAL STRUT FRAMING SYSTEMS:

- A. Shall be a basic adjustable slotted steel framing system consisting of components specifically designed for the support of mechanical and electrical systems. Parts shall include modular type channels, available with or without bolt holes, knockouts, or slots, with fittings and hardware requiring no welding, drilling, or other complex fabrication techniques. Basic attachment to channel shall be by means of spring mounted gripping nuts with serrated grooves, and bolts.
- B. Available accessories shall include brackets, baseplates, rod connectors, pipe and conduit straps, pipe and conduit hangers, beam clamps, cable clamps, concrete inserts and closure strips.
- C. Loading shall not exceed manufacturer's published load capacities for parts, connections, and assemblies for the actual spans involved.
- D. Shall be UL listed for the purpose when utilized as electrical raceway.
- E. Acceptable Manufacturers - B-Line, Elcen, F and S, Kindorf, Power Strut, Unistrut.

2.9 SLEEVES, INSERTS, ANCHORS AND SUPPORTS:

- A. Provide in concrete, carpentry or masonry construction, hangers, sleeves, expansion bolts, inserts, supporting steel, or other fixtures necessary for the support of pipe, equipment and devices furnished under each Section of the Specifications.
- B. Provide each pipe, conduit, or duct passing through walls, floors, ceilings or partitions with sleeves having internal dimension approximately 1-inch larger than the outside dimension (including installation) of pipes, conduits or ducts.
- C. Sleeves through interior partitions and floors shall be no less than 22 gage galvanized steel, set flush with the finished surfaces.
- D. Sleeves through mechanical room floor shall match existing.
- E. Attachments to structure shall be by means of beam clamps wherever practicable.
- F. Acceptable Manufacturers - Grinnell, Hilti, Phillips, or Thunderline.

2.10 FIRE STOPPING:

- A. Seal annular spaces between sleeves and penetrating materials in fire rated floors, ceilings, and walls with fireproof and waterproof silicone elastomer applied in accordance with the manufacturer's published instructions. Multiple penetrations shall be sealed with silicone caulking. Seal material shall be UL classified for use in fire rated penetration seals, and shall be

applied in the manufacturer's recommended thickness for the fire rating of the penetrated structure in accordance with ASTM-E-814 requirements.

- B. Acceptable Manufacturers - Dow Corning, General Electric, Hilti.

2.11 WATERPROOFING:

- A. Seal penetrations of wet or potentially wet structures, floors, exterior walls, etc., other than those requiring fire stopping, with sealant to prevent moisture leakage. Apply sealing material (calking) in accordance with manufacturer's published instructions.
- B. Product Research and Chemical Co. "Poly-Sulphide Sealant" PRC- 5000.

2.12 AUXILIARY STRUCTURAL SUPPORTS:

- A. Provide auxiliary structural supports as necessary to support mechanical systems from the building structure. Coordinate with structural drawings. Supporting members shall be metal strut framing or standard structural shapes, designed to support imposed loads with a working stress no greater than 25 percent of ultimate stress values of the members, and articulation with the building structure without exceeding structural limitations at the point of attachment to the building structure. Prepare calculations and Shop Drawings of each such support and submit for acceptance. Begin no work until receipt of acceptance from the structural engineer.

2.13 ESCUTCHEONS:

- A. Provide escutcheons or 22 gage minimum painted galvanized sheet metal wall flanges (in event standard manufactured product does not exist) for mechanical or electrical penetrations of floors, ceilings, walls or partitions. Escutcheons shall be sized to enclosed the outside of the penetration sleeve and fit snugly to the pipe (or over outside of insulation) of insulated lines. Both exposed surfaces of such penetrated elements shall be fitted with escutcheons which shall both afford a finished appearance and prevent passage of vermin.
- B. Except where otherwise specified, escutcheons shall be one- piece (where practicable) or split, hinged, stamped brass type designed to fit the pipe, and to cover the terminating pipe sleeve, in chrome plated finish, with securing device to hold the escutcheon tight to the pipe.
- C. Use deep escutcheon on each sleeve set in a waterproof concrete floor.
- D. Acceptable Manufacturers - Beaton and Corbin, Grinnell, Sweet and Donaldson.

2.14 ROOFTOP EQUIPMENT SUPPORTS AND PIPE CURBS:

- A. Provide insulated, leakproof equipment supports and pipe curbs approved by the National Roofing Contractor's Association for roof mounted equipment, pipe, or conduits. Supports shall be prefabricated of continuous welded 18 gage minimum galvanized steel, 12-inch minimum height, mitered corner seams, integral cant and base plate, 2 x 4 fire resistant treated wood

nailer, and 18 gage counterflashing. Provide integral internal reinforcing necessary to support imposed load, but no less than 600 pounds per linear foot of perimeter.

- B. Provide raised cant, thickness to match thickness of roof insulation.
- C. Top surface shall be level. Provide pitched base where installed on pitched roof.
- D. For pipe curbs, coordinate conduit requirements with Division 26, to provide required openings in a single curb.
- E. Acceptable Manufacturers - Pate, Roof Products Systems, Stiles, Thycurb.

2.15 FLASHINGS:

- A. Furnish weatherproof flashings for mechanical system related openings through the roof and walls.
- B. Furnish roof flashing for round and rectangular openings, pipes, vents, machinery, devices, or ducts. The flashings shall be constructed to terminate not less than 12-inches above the roof. Provide suitable counterflashing constructed from the same material as the flashing.
- C. Furnish flashings for mechanical curbs, and furnish and install counterflashing at each.

2.16 PIPE HANGERS AND SUPPORTS:

- A. Hold piping in place by accepted hangers, supports and anchors, designed to support weight of pipe, weight of fluid and weight of pipe insulation. Arrange hangers to prevent transmission of vibration from piping to building and supports. Allow clearance for application of specified vapor sealed insulation without cutting pipeline covering or fitting covering in installation of pipe hangers and fittings. Uninsulated copper or brass pipe or tubing shall be isolated from ferrous hangers or supports. Piping shall not be supported from roof decking. Furnish and install angle members to span steel joists or distribute load.
- B. Suspend and support horizontal and vertical piping from the structure with hangers and metal strut framing system or structural steel supports, spaced as scheduled. Furnish necessary accessories, nuts, lock nuts, bolts, rods and devices to allow installation to freely expand and contract. Hangers shall be formed steel clevis type, unless otherwise specified, with adjustable attachment to hanger rod. For copper or brass pipe, use plastic sheathed hangers to eliminate all possibility of galvanic action between hanger and copper tubing. Pipe hangers shall fit over vapor sealed insulated piping.
 - 1. Clevis - Grinnell Fig. 260 or 590.
 - 2. Uninsulated copper tubing - Grinnell Fig. CT-99C.
- C. Where pipe exceeds maximum loading recommended for clevis type hanger and for attachment to vertical pipes, provide steel pipe clamps.
 - 1. Double bolt pipe clamps - Grinnell Fig. 295.
 - 2. Riser clamps - Grinnell Fig. 261.

3. Copper tubing riser clamps - Grinnell Fig. CT-121-C.
- D. Provide trapeze hangers where several pipes can be installed parallel and at same level. Trapeze of standard structural steel shapes sized to support load and drilled for rod hanger at each end.
 1. Grinnell Fig. 46.
 - E. Use roller supports with cast iron adjustable bases, where provision for expansion is required.
 1. Grinnell Fig. 274.
 - F. For hanger rods on piping 3/4-inch thru 2-inch inclusive, use 3/8-inch thru 3 1/2-inch inclusive, use 1/2-inch rods; for 4- inch thru 5-inch inclusive, use 5/8-inch rods; for 6-inch, use 3/4-inch rods; for 8-inch thru 12-inch, use 7/8-inch rods; and for piping larger than 12-inches, use 1-inch rods.
 - G. Provide additional steel members required for hanging piping systems in areas with special conditions, or where vertical or horizontal structural steel supports are required other than those provided in the structure.
 - H. Provide oversize hangers with hanger shields or blocking the same thickness as insulation to pitch insulated pipes accurately at time of installation.
 - I. C-Type hangers on sprinkler piping shall have lock nuts.
 - J. Attach supporting rods to concrete by drilled anchors or inserts placed before concrete is poured.
 - K. Provide lateral bracing for supporting rods over 18-inches long braced at every fourth hanger with diagonal bracing attached to slab or beam.
 - L. Attach supporting rods to precast structural members on sides by expansion bolts located above steel reinforcing at minimum of 6-inches above the bottom. Power driven devices shall not be used.
 - M. Floor Supports - Provide for supporting horizontal piping from floors with cast-iron pipe rests, with pipe nipples to suit. Fasten to floor. Where provision for expansion is required, provide pipe roll stands, without vertical adjustment. Provide concrete or steel pipe piers; fasten stands to piers.
 - N. Wall Supports - Provide for supporting horizontal piping from wall with steel J-hook for pipe located close to wall and no larger than 3-inch pipe. For greater loads, up to 1500-pound maximum loading, provide welded steel bracket.
 - O. Use inserts of drilled anchors in concrete construction, use beam clamps in steel construction.
 - P. Hanger spacing schedule, except for nonmetallic, cast iron, or fire protection systems, shall be as follows:
 1. 1/2 and 3/4-inches 6-feet
 2. 1-inch 7-feet

- | | | |
|----|----------------------|---------|
| 3. | 1 1/4-inch | 8-feet |
| 4. | 1 1/2-inch | 9-feet |
| 5. | 2-inch | 10-feet |
| 6. | Larger than 2-inches | 12-feet |

- Q. Furnish miscellaneous steel necessary to support piping systems, including those accessories required for trapeze or group hanging.
- R. Acceptable Manufacturers - B-Line, Grinnell, Burt Patterson, Elgen, F and S Fee and Mason, Michigan, Modern.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT:

- A. Protect equipment from physical damage and deterioration after it is delivered to the Project, and during the installation period prior to Owner acceptance.
- B. The equipment shall be kept clean. Motors and electrical devices shall be covered with suitable materials to prevent dirt or dust accumulation within equipment. Machinery and devices shall be properly oiled and maintained to prevent rusting and deterioration.
- C. Repair scratches, mars, or paint deterioration.

3.2 EXCAVATION AND BACKFILL

- A. Perform excavation and backfill required for the installation of underground pipe, ducts, equipment and devices.
- B. Cut trenches true and straight and grade bottom to afford uniform bearing of barrel on firm soil. Stack the excavation material in a suitable location. Shore trenches and excavated areas as required for safety, and for security of adjacent earth and structures.
- C. Cut through walks, roads, and other structures as necessary for the installation.
- D. Install underground mechanical piping and ducts with a minimum cover of 24-inches from finished grade, or as detailed on plans. Pipes carrying water shall be installed a minimum of six inches below the frost line.
- E. Trench width at and below top of pipe shall result in horizontal clearance between trench wall and barrel on both sides.
- F. Pipes smaller than 18-inch - at least 6, but no more than 8-inch clearance.
- G. Prepare trench bottom. Dig out of joints. Lay pipe in trench so that entire length bears on firm soil. No part of bell fittings shall support the remainder of the pipe.

- H. Provide embedment where indicated or if trench is unsuitable for support. Cut excavation a minimum of 6-inches below the required grade. A 6-inch bed of sand shall then be placed and properly compacted to provide accurate grade, and uniform bearing throughout the length of pipe or conduit. The sand shall consist of clean, natural, washed sand with particle sizes which will pass through a 3/8-inch screen, 90 percent through a quarter inch screen, and no more than 25 percent through a No. 50 screen.
- I. The backfilling shall not be placed until the Work has been inspected, tested and accepted.
- J. Backfill material shall be free of cinder or rocks, and free of clods or lumps larger than 1-inch, up to 12-inches above top of pipe, and 2-inches in remainder. If the excavated material is not suitable, provide adequate material from other locations.
- K. Backfill by installing clean earth in accordance with the above Specifications in layers no more than 6-inches thick, tamping (and wetting down, if necessary). Hand place and tamp each layer of initial backfill in 4-inch layers up to pipe centerline, and in 6-inch layers up to 12-inches above the top of pipe. Complete backfill to grade and create a substantial, well-compacted trench to 95 percent compaction by the standard Proctor test.
- L. Surplus earth or materials remaining after backfilling shall be removed from the site.
- M. Repair utilities, lines, walks, and roads, and other surfaces and structures damaged by these operations to match conditions existing prior to excavation.

3.3 EQUIPMENT SPACE:

- A. The Drawings indicate specified products physically arranged in the spaces, as cataloged by specific manufacturers, generally as listed in the Equipment Schedule.
- B. Coordinate the exact physical space requirements for equipment and servicing of equipment actually purchased for each item of equipment involved.
- C. Drawings show pipe and ductwork diagrammatically.
- D. Adhere to Drawings as closely as possible in layout of work.
- E. Vary run of piping, run and shape of ductwork and make offset during progress of work as required to meet structural and other interferences.
- F. Install piping and ductwork in furred spaces wherever possible. Run exposed piping and ductwork parallel to or at right angles to buildings walls.
- G. Keep horizontal lines as close to ceiling as practicable.
- H. Conform to ceiling heights established on architectural construction drawings.
- I. All equipment shall be installed to provide complete access for service, adjustment and filter replacement, as well as complete removal/replacement of unit from equipment room. Coordinate installation with all other trades to ensure that no piping, conduit, ductwork, structure, light fixtures, or other equipment obstruct complete access to the equipment.

Coordinate access requirements for equipment actually provided with equipment manufacturer. Equipment installation shall not impede access to room. Equipment installed in violation of these requirements will be removed and re-installed at contractor's expense.

3.4 INTERFERENCES:

- A. Relocate or reroute existing pipe, wiring, or ducts as required to facilitate construction of finished work as planned. Restore surfaces, insulation, and finish to match condition of adjacent work.

3.5 CUTTING AND PATCHING:

- A. Assume costs and responsibility for cutting and patching required to complete the installation.

3.6 PAINTING AND FINISHING AND CLEANING:

- A. Provide touchup painting of prefinished mechanical products.
- B. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish ready for finish coats.
 - 1. Piping, ductwork and equipment - Clean exterior of piping, ductwork and equipment, removing rust, plaster and dirt by wire brushing. Remove grease, oil, and similar materials by wiping with clean rags and suitable solvents.
 - 2. Motors, pumps and other items with factory finish - Remove grease and oil and leave surfaces clean and polished.
 - 3. Plumbing Fixtures - Clean and polish fixtures immediately prior to final inspection.
- C. Cleaning operations are supplemented by detailed instructions for specific systems.

3.7 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES:

- A. Air supply outlets, return air inlets, exhaust air inlets, plumbing fixtures, and sprinkler heads may be relocated at the Owner's option to points within 10-feet of their indicated locations, at no additional cost to the Owner, provided the Contractor is notified prior to Shop Drawing preparation or roughing-in and fabrication.
- B. Only work which must be re-performed in this connection will be considered extra.

3.8 MECHANICAL SYSTEM VERIFICATION AND CALIBRATION:

- A. The mechanical contractor shall coordinate on-site system verification and calibration session(s) to document that the systems listed below are operating as intended. As a minimum, one 8-hour day shall be scheduled for the first session. Subsequent sessions shall be scheduled as needed until final verifications and calibration are complete.

1. The session shall follow complete installation and startup of all HVAC systems and the initial test and balance adjustments so that the integration effort will achieve the scheduled operation of each system.
- B. Session(s) shall be scheduled in advance and the General Contractor, Owner and Engineer shall be invited to attend.
- C. On-site attendance and participation in each session is mandatory for the following parties:
 1. Equipment/system installing contractor.
 2. Equipment manufacturer's factory authorized representative(s).
 3. Temperature Controls Contractor.
 4. Test and Balance Contractor.
- D. Parts, tools and expertise:
 1. The attending contractors and sub-contractors shall be equipped with typical components and materials to make corrections, adjustments and repairs of the installed equipment.
 2. The participants shall bring necessary tools and special equipment needed to make corrections or adjustments of the installed equipment and sub-systems where operation is being verified and/or calibrated.
 3. Personnel with the expertise to make full adjustments and/or programming changes shall be in attendance.
- E. Documentation of system verification and calibration:
 1. Verify the system operation through full operating range is correct by testing and measurement of the controlled variables and response of equipment during automatic operation. Verify through complete operating sequences put into effect by simulation of seasonal conditions by temporary adjustment of system setpoints and necessary control points.
 2. The equipment/system Contractor shall prepare a record of the findings of the verification and calibration of each equipment item and/or system. The recorded findings shall identify the sequences verified and whether they were accepted or failed. Verification of system operation shall include:
 - a. Operation sequences.
 - b. Set points.
 - c. Calibration and coordination of installed sensors and instrumentation.
 3. The Contractor shall identify items that do not operate as expected and those requiring further verification
- F. These requirements shall apply to the following equipment/systems:
 1. New HVAC systems and equipment.
 2. Temperature controls.
- G. The Mechanical Contractor shall submit a report documenting the verification sessions and results for each piece of equipment affected. All deficiencies and deviations from the specified performance shall be documented.

END OF SECTION 23 01 00

SECTION 23 25 00 - INSULATION (MECHANICAL)

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Thermal insulation of piping systems, plumbing, casings and equipment installed under other Sections of these Specifications.

1.2 REFERENCE STANDARDS:

- A. ASHRAE 90A - 1980, Section 5.
- B. NFPA 90A, Air Conditioning and Ventilation Systems.
- C. UL Guide No. V.8.15 (Jackets, Adhesives and Sealers).
- D. SMACNA, Sheet Metal and Air Conditioning Contractors National Association.

1.3 SUBMITTALS:

- A. Submit manufacturer's product data on insulation materials, jackets, accessory materials, adhesives, tapes, etc. Submit a schedule for each class of insulation specified, indicating product, thickness, quantities, sizes, installation details, and surfaces to which each class is to be applied.
- B. See Section 23 01 00.

1.4 QUALIFICATIONS:

- A. Insulation shall be installed by a firm whose principal business is the application and installation of thermal insulating material on piping and duct systems. Materials shall be by recognized manufacturers and shall be installed by skilled mechanics in accordance with manufacturer's standard published instructions except as otherwise specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Accessory Materials - Childers, Fosters, P.K. Insulation, Vimasco.

- B. Insulation Material - Armstrong Cork, CertainTeed, Delta Systems, Inc., E.O. Wood, Fibrex, Knauf Fiber Glass, Manville, Owens-Corning Fiberglass, Partek.

2.2 ACCESSORY MATERIALS:

- A. Hanger Adhesive - Foster 55, red-brown, or approved equivalent.
- B. Insulating Cement - P.K. Insulation Quick Coat or One Coat, or approved equivalent.
- C. Metal Bands - 1/2-inch wide, 0.20-inch thick aluminum.
- D. Flexible Cellular Insulation Adhesive - Armstrong 520 or Foster 82-40, or approved equivalent.
- E. Glass Fabric Cloth - 8 ounce per square yard sized woven cloth.
- F. Glass Fabric Cloth Jacket Sealer, UL listed lagging adhesive, white - Foster 30-36, or Childers CP-50 pigmented, or approved equivalent.
- G. Vapor Barrier Mastic, White - Foster 30-35 or Childers CP-30, or approved equivalent.
- H. Weather Barrier Mastic, White - Foster 35-00 or Childers CP-10, or approved equivalent UL classified outdoor grade elastomeric vinyl mastic.
- I. Fiberglass Insulation Bonding Adhesive, Amber-Foster 85-15 or Childers CP-82, or approved equivalent.
- J. Mechanical Surface Fasteners – Benjamin Foster, Duro Dyne, Manville.

2.3 INSULATION JACKETS:

- A. ASJ Jacket - All Service Jacket - Vinyl coated and embossed vapor barrier laminate of 40 pcf white kraft, aluminum foil, and flame snuffing adhesive, reinforced with glass fibers, 0.05 permeability rating.
- B. PVC Jacket - 20 mil minimum thickness polyvinyl chloride pipe and fitting jacketing, UV resistant with maximum of 25/50 flame/smoke spread rating per ASTM 84. Install with waterproof solvent welding contact adhesive, vapor barrier mastic adhesive, and PVC tape. Do not staple or penetrate vapor barrier.
 - 1. Equivalent to Johns Manville Zeston.

2.4 TYPE FDL INSULATION:

- A. Fiberglass Duct Liner, blanket material in roll form, meeting the requirements of ASTM C1071 and the additional following requirements.

1. Have a potential heat value not exceeding 3500 btu/lb when tested in accordance with NFPA 259 and meeting the classification of “Limited Combustible” as defined by NFPA 90A.
2. Maximum rated velocity not less than 5000 FPM when tested in accordance with ASTM C 1071.
3. Resistant to microbial growth using a “no growth criteria” when tested in accordance with ASTM C 1138, G 21 and G22.
4. Have a maximum thermal conductivity(k-value), at 75°F mean temperature, of .24 Btu.●in/hr.●sq.ft.●°F.
5. Sound absorption coefficients and NRC shall meet or exceed the following when tested in accordance with ASTM C 423 using an “A” mounting.

Thickness	Type	Absorption Coefficients @ Octave Band Frequencies (Hz)						
		125	250	500	1000	2000	4000	NRC
1/2"	200	.05	.15	.35	.61	.75	.88	.45
1"	150	.06	.27	.66	.87	.98	.99	.70
1-1/2"	150	.18	.53	.97	1.06	1.06	.90	.90
2"	150	.24	.74	1.12	1.11	1.07	1.08	1.00

- B. Fiberglass Duct Liner shall be equivalent to Certainteed Tough Gard R.

2.5 TYPE FDB INSULATION:

- A. Foil Faced Fiberglass Duct Wrap Blanket, UL labeled, reinforced foil kraft vapor barrier jacket, 0.30 K factor 75°F, mechanically fastened to duct using insulation pins welded to duct. Insulation pins shall not penetrate to the inside of ducts.
- B. Conforming to FS HH-I-558B, Form B, Type 1, Class 6, ASTM C- 553.
- C. Acceptable Manufacturers: Minnesota Mining Manufacturing (3M), Nelson, Premier, Unifrax.

2.6 TYPE FPC INSULATION:

- A. Fiberglass Pipe Covering, 0.23 K factor at 75 F., molded in cylindrical form to fit pipe snugly, sectional one-piece construction, with factory applied flame resistant vapor barrier jacket with double self-sealing flap.
- B. Conforming to FS HH-I-558B Form D, Type 3, Class 12 and ASTM C547.

2.7 TYPE PFP INSULATION:

- A. Plastic Flexible Pipe Covering - Flexible closed cell fire resistant foamed plastic material, 0.10 water vapor permeability per ASTM E96 procedure A, , 0.27 K factor at 75°F per ASTM C177 or C518, 5% water absorption by weight per ASTM D1056, molded in cylindrical form to fit pipe snugly. The insulation shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as tested by ASTM E84-91A. The insulation shall be equivalent to AP Armaflex.

2.8 PIPE INSULATION SADDLES:

- A. Provide 180 degree, 16 gauge galvanized steel protection saddle, 12 inches long, at individual pipe hanger support locations.
- B. Provide 360 degree, 16 gauge galvanized steel protection saddle, 12 inches long, at each pipe which is clamped to a trapeze hanger.

2.9 HANGER SHIELDS:

- A. Provide penetration shields to encase insulated pipes penetrating fire walls or floors in a 360 degree, 24 gage minimum sheet metal hanger shield with insert of high density, 100 psi, waterproofed calcium silicate the same thickness as insulation and further enclosed within the sleeve, sized for maximum 1-inch spacing between sleeve and insulation shield. Pack annular space between sleeve and shield as specified under "Fire-Stopping" in the Section 23 01 00. Install an escutcheon plate to completely cover the wall penetration opening and fit snugly over the pipe insulation shield. Insert shall extend at least 1-inch beyond penetrated surface and escutcheon.

2.10 ADHESIVES, MASTICS AND SEALANTS:

- A. Utilize materials recommended by insulation manufacturer for the application.
- B. 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.

2.11 PIPE INSULATION FITTINGS:

- A. Fittings shall be premolded of the same material and thickness as the pipe covering and provided with a matching vaporproof barrier, or build up the fittings from segments of pipe insulation or fibrous glass blanket to the proper thickness and then finish with fire retardant tape and vaporproof barrier. Fittings so covered shall be finished with a fire retardant covering to form a smooth, neat appearance similar to that on the straight length of pipe.
- B. Valves, strainers, expansion tanks, and similar appurtenances shall be insulated as specified for fittings except that valve bonnets and strainer cleanouts need not be insulated.
- C. One-piece premolded PVC fitting and valve covers may be provided in lieu of fitting jacketing specified.
- D. Where Type ASJ jacketing is specified, one-piece premolded PVC fitting and valve covers may be provided in lieu of fitting jacketing specified.

PART 3 - EXECUTION

3.1 VAPOR SEALED PIPE INSULATION APPLICATION:

- A. Apply insulation only to clean dry pipe after it has been thoroughly tested. Each section of insulation shall be firmly butted together with the end surface of a section of covering having the entire surface buttered with vapor barrier cement and the adjacent end surface of the next section of covering pushed tight to this mastic and vapor sealed.
- B. In areas subject to physical abuse, such as gymnasiums, and when recommended by insulation manufacturer, apply outwardly clinched staples, minimum three per length of insulation. Seal all staple locations with white vapor barrier cement.
- C. At points where pipe hangers occur, insulation damage shall be prevented.

3.2 FLEXIBLE FOAMED PLASTIC PIPE INSULATION APPLICATION:

- A. Insulation shall be cylindrical without longitudinal joint and slipped over the pipe prior to erection wherever possible. Seal circumferential butt joints with flexible tubing adhesive. Where slip-on technique is not possible, insulation shall be slit longitudinally, applied to pipe, and longitudinal and circumferential joints sealed with flexible tubing adhesive.

3.3 DOMESTIC COLD AND HOT WATER PIPING:

- A. Insulate in their entirety except do not insulate 1/2-inch and smaller branches in pipe chases serving single fixtures or horizontal stubouts directly to fixtures from pipe chases or chrome plated pipe.
- B. Insulate hot and cold water and waste piping beneath handicapped sinks. Provide manufactured piping covers consisting of flexible vinyl insulation with white finish and access to piping, equivalent to Handi Lav-Guard manufactured by Truebro, Inc.
- C. Utilize PFP insulation for hot water below grade, FPC insulation for cold and hot water above grade.

3.4 COLD DRAIN PIPING:

- A. Insulate condensate drain piping completely from the unit drain pan to the point of connection to the sanitary waste system.
 - 1. Exception - Condensate drain piping inside of mechanical rooms does not require insulation.
- B. Cold Condensate or Electric Water Cooler Drains – Insulate sanitary waste above grade from drain receiving cold liquid to point of connection to vertical stack or sanitary waste affording dilution adequate to preclude condensation on uninsulated pipe, including "P" trap and vertical piping down to the first elbow.

- C. Rain Water Drain Piping - Insulate only those portions of the downspouts above grade which run horizontally, including the elbow turned down and the elbow turned up, to and including portions of the roof drains below the roof and vertical piping down through the first elbow.

3.5 DUCT INSULATION:

- A. Insulate ductwork as scheduled in this Section. Material shall be as specified for each insulation class.
- B. Provide access door insulation so that doors can be opened without damaging insulation.
- C. Install type FBW insulation in strict accordance with the manufacturer's recommended installation procedure for grease and air duct for zero clearance to combustibles and 2-hour rated duct enclosure. The completed installation shall be in accordance with the product's UL listed assembly.
- D. Do not insulate preinsulated ductwork or flexible runouts.

3.6 DUCT LINER:

- A. Fabrication and installation shall conform to manufacturer's recommendations and to the requirements of the latest edition of the North American Insulation Manufacturers Association's *Fibrous Glass Duct Liner Standard*, or of the Sheet Metal and Air Conditioning Contractors National Association *HVAC Duct Construction Standards - Metal and Flexible*) or the manufactures recommendations.
- B. All portions of duct designated to receive duct liner shall be completely covered with duct liner. All joints shall be neatly butted and there shall be no interruptions or gaps. Duct liner shall be installed with the black surface treatment exposed to the air stream.
- C. Duct liner shall be adhered to the sheet metal with 90% (minimum) coverage of adhesive complying with the requirements of ASTM C 916.
- D. All transverse edges that are not to receive sheet metal nosing shall be coated. Longitudinal joints shall occur at the corners of ducts. If duct size and standard duct liner product dimensions make exposed longitudinal joints necessary, such joints shall be coated with adhesive designated for duct liner application and which meets the requirements of ASTM C 916. Such joints shall be additionally secured with mechanical fasteners in accordance with NAIMA FGDLS, or SMACNA HVAC DCS as if they were transverse joints.
- E. Duct liner shall be additionally secured with mechanical fasteners complying with the requirements NAIMA FGDLS or SMACNA HVAC DCS and of the correct type for the duct liner being installed. Fasteners shall be weld-secured, shall be installed perpendicular to the duct surface and shall penetrate to the outside of ducts. Mechanical fasteners shall not compress the insulation more than 1/8" (3 mm) based on nominal insulation thickness. Fastener spacing with respect to interior duct dimensions shall be in accordance with NAIMA

FGDLS or SMACNA HVAC DCS. Fastener heads or washers shall have a minimum area of 0.75 in² (484 mm²), with beveled or cupped edges to prevent their cutting into the duct liner.

- F. Where air velocities exceed 4000 fpm (20.3 m/sec), metal nosing (either channel or "zee" profile) shall be installed on upstream edges of liner duct sections.
- G. Metal nosing shall be securely installed over transverse liner edges facing the airstream at fan discharge and at any point where lined duct is preceded by unlined duct.
- H. Duct liner in roll form shall be folded and compressed in the corners of rectangular duct sections, or shall be cut and fit to assure a lapped, compressed corner joint
- I. Duct liner in sheet form shall be cut and fit to assure tight, over-lapped corner joints. Top pieces of liner shall be supported at the edges by the side pieces
- J. Any damage to the air stream surface must be repaired by coating the damaged area with adhesive or coating designed for duct liner application. Adhesive or coating shall meet requirements of ASTM C916
- K. Field Quality Control
 - 1. Upon completion of installation of lined duct and before HVAC system start-up, visually inspect the ductwork and verify that duct liner has been correctly installed. Confirm that the duct system is free from construction debris.
 - 2. After the lined duct system is completely installed and ready for service, conduct a final inspection of the entire system. This inspection should include, at minimum, the following steps:
 - 3. Check all registers, grilles, and diffusers to ensure that they are clean and free from construction debris.
 - 4. Check all filters in accordance with their manufacturer's instructions. Use specified grade of filters at all times that system is operating.
 - 5. Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork.
 - 6. Turn the HVAC system on and allow it to run until steady state operation is reached.
 - 7. Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.
- L. Protection
 - 1. Contractor' employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats and eye protection.
 - 2. The contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.7 DUCT INSULATION SCHEDULE:

Note: All ductwork shall be either insulated or lined unless specifically noted otherwise below or on plans.

		TYPE	THICKNESS (Inches)
A.	Rectangular Supply Duct Inside Building	FDL	½
B.	Rectangular Return Duct Inside Building	FDL	½
C.	Round Supply Duct	FDB	1 ½
D.	Rectangular Exhaust Duct	FDL	1/2
E.	Round Exhaust Duct	---	---

3.8 PIPE INSULATION SCHEDULE:

	PIPE SIZE (Inches)	INSULATION TYPE	THICKNESS (Inches)	JACKET TYPE	
A.	Domestic cold water above grade	All	FPC	½	ASJ*
B.	Domestic cold water below grade	All	---	---	---
C.	Domestic hot water & recirculating above grade	All	FPC	1	ASJ*
D.	Domestic hot water & recirculating below grade	All	PFP	1	---
E.	Condensate drain piping	All	FPC	1	PVC

*Apply PVC jacket to all insulated piping installed exposed in rooms, freezers and coolers.

END OF SECTION 23 25 00

SECTION 23 65 10 - ROOFTOP HEATING/COOLING UNITS**PART 1 - GENERAL****1.1 WORK INCLUDED:**

- A. Provide labor and equipment, materials and transportation to receive, install and put into operation roof top air conditioning equipment as specified, scheduled, shown, or detailed in the Project Documents.
- B. This Contractor shall be responsible for the complete installation of the control systems for all roof top heating/cooling units specified herein, including all wiring, thermostats and ancillary equipment necessary to provide a complete and fully operative control system as specified or scheduled. Where required by applicable codes, this contractor shall provide the services of a licensed electrician to complete this work. Where indicated on plans, the electrical contractor will provide an empty box and conduit for the thermostat and controls wiring.

1.2 SUBMITTAL DATA:

- A. Submit complete printed catalog and descriptive data for each major piece of equipment. Include:
 - 1. Equipment, piping and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections
 - 2. Piping, valves and fittings shipped loose showing final location in assembly
 - 3. Control equipment shipped loose, showing final location in assembly
 - 4. Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads
 - 5. Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers
 - 6. Fan performance curves
 - 7. Details of vibration isolation
 - 8. Estimate of sound levels to be expected across individual octave bands in db
 - 9. Type of refrigerant used
 - 10. Plan view, front view end view, back view and curb detail with dimensions
 - 11. Quality Assurance:
 - a. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties
 - b. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements
 - c. Manufacturer's Instructions: Manufacturer's installation instructions
 - 12. Manufacturer's Field Reports: Manufacturer's field reports specified herein
 - 13. Closeout Submittals: Submit the following:

- a. Warranty: Warranty documents specified herein
 - b. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance. Include names and addresses of spare part suppliers
 - c. Provide brief description of unit, with details of function, operation, control and component service
 - d. Provide equipment inspection report and equipment operation test report
- B. See Section 23 01 00.

1.3 REFRIGERANT AND OIL:

- A. Furnish an adequate supply of refrigerant and oil, and maintain refrigerant and oil in the system in proper quantities for one year warranty period from the date of acceptance by the Owner. Any source of leakage necessitating addition of refrigerant or oil during warranty period shall be found and corrected.
- B. Refrigerant or oil lost or contaminated during the warranty period shall be provided without additional charge for both labor and material.

1.4 WARRANTY:

- A. Refrigeration compressors shall be warranted for five years.
- B. Stainless steel heat exchanger furnace shall carry a 25 year non-prorated warranty.
- C. All other unit components shall be warranted for one year.

PART 2 - PRODUCTS

2.1 ROOFTOP AIR CONDITIONING UNITS:

- A. One-piece, air-to-air, factory assembled, precharged, piped, and wired packaged unit. The manufacturer shall test operate unit at the factory prior to shipment.
- B. Provide leakproof, insulated roof mounting curb approved by the National Roofing Contractor's Association, with built-in cant strip and flashing constructed of 14 gage minimum thickness galvanized steel, 14-inch minimum height, designed to form a waterproof assembly when the unit is installed. Curb shall be full perimeter design with all service connections within the curb area, "structural" type, arranged to span between supports. Top surface shall be level (provide pitched curb when installed on pitched roof). Coordinate roof curb with roof type and slope to ensure compatibility. Provide adaptor curb where required to mount new unit on existing curb.
- C. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
 3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
 4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Electrical conduit through cabinet panels shall include sealing to reduce air leakage.
 5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
 6. Access to filters, dampers, heaters, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
 7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 8. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
- D. Compressor(s) shall be hermetic scroll type, with crankcase heater, vibration isolation, and filter drier(s). Motor compressor units shall be warranted for five years.
1. Compressors shall be refrigerant cooled, resiliently mounted on rubber mounts for vibration isolation, and isolated from condenser and evaporator fan air streams
 2. Refrigerant shall be 410A.
 3. Units with a nominal capacity of 7.5 tons and greater shall be provided with multiple compressors and a separate refrigerant circuit for each compressor.
- E. Coils:
1. Evaporator Coils and hot gas reheat coils shall be aluminum plate fins mechanically bonded to copper tubes, with balanced port thermal expansion valves, freeze protection on each circuit, pressure and leak tested to 500 psi.
 2. Condenser coils shall be aluminum lanced fins thermally bonded to aluminum flat tube.
- F. Supply Fans
1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
 2. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.
 3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

- G. Outdoor air fans shall be direct drive propeller type, with inherent motor protection. See Section 23 01 00 for motors.
- H. Units with gas heat shall have a redundant gas valve to achieve 100% pilot shutoff when there is no call for heat as well as the standard gas valve for controlling the main burner, automatic spark ignition system, limit switch, flame rollout switch, induced draft fan and draft failure switch.
- I. Gas burners shall be stainless steel. Multicell heat exchangers shall be heavy gage steel. Heat exchangers shall have a 25-year warranty.
- J. Units shall contain the following safety controls-
1. Low and high pressure cutouts on each circuit.
 2. TXV with removable element head on each circuit.
 3. Modulating hot-gas reheat control valve.
 4. Crankcase heater on each compressor.
 5. Compressor motor overloads.
 6. Timer to limit compressor starts to not more than one each 5 minutes (adjustable).
 7. Low ambient control to allow compressor operation to 40°F and to prevent compressor operation below 40°F (adjustable) outside air temperature.
- K. Units shall be factory wired for single point electrical connection.
- L. On units 2,000 to 15,000 cfm, Install a UL approved smoke detector, provided by the electrical contractor or by the unit manufacturer as scheduled, and installed by the mechanical contractor in the return air path, arranged to shut down the unit fan(s) upon detection of smoke. Coordinate installation of the remote test switch, and interface with building fire alarm system, as applicable, with electrical contractor.
- M. Air Filters -
1. Rooftop Air Conditioning Units shall be provided from factory with 2" thick filter frames.
 2. Provide temporary filter elements in the filter banks of supply systems used during construction prior to using the system.
 3. Temporary filter elements may be either throw-away type with frames taped air-tight or as scheduled for the system.
 4. Immediately prior to test and balance operations, replace temporary filters with a new set of scheduled filter elements.
 5. After final acceptance, a new set of scheduled filter elements shall either be delivered to Owner or installed to replace "test" filters, as directed by Owner.
 6. Filter Elements - Type MEPM - medium efficiency pleated media - 2-inch thick disposable type of pre-formed pleated, non-woven, cotton fabric media continuously laminated to a supporting steel wire grid conforming to the configuration of the pleat, sealed in a chip board media frame, minimum 25 percent average NBS efficiency with atmospheric dust. Maximum 0.38-inches WC initial resistance at 500 fpm face velocity. Minimum MERV 7.
- N. Provide each unit with a low leakage, motorized damper. When scheduled, each unit shall be equipped with an economizer package for "free cooling" with outside air. Package shall contain -

1. Low leakage dampers.
 2. Powered exhaust fans, when scheduled.
 3. Spring return damper operators.
 4. Capability of simultaneous economizer cooling and mechanical cooling.
 5. Discharge air sensor and enthalpy changeover for damper control.
 6. Outdoor air thermostat (adjustable) to lock out mechanical cooling when outdoor air temperature is below setpoint.
 7. When scheduled, a field or factory-installed (as scheduled) indoor air quality (carbon dioxide) sensor to adjust damper position proportionally to pollutant level.
 8. Associated controls, related equipment and circuiting.
- O. When scheduled, provide units with:
1. Modulating hot gas reheat capability. Furnish zone humidity sensor with unit.
 2. Additional features as scheduled.
- P. Provide units with factory mounted and wired non-fused power disconnect switch, and factory mounted and wired ground fault interrupting, weatherproof power receptacle with in-use cover. Receptacle shall remain energized when disconnect is turned off.
- Q. Controls:
1. Field Installed DDC Controls –
 - a. Controls shall be field provided and field installed by others. Unit shall be provided with a terminal strip for low voltage wiring connections by the temperature controls contractor.
- R. Acceptable Manufacturers: Aeon, Daiken, Trane Horizon, Valent.

PART 3 - EXECUTION

3.1 MANUFACTURER'S DIRECTIONS:

- A. Install equipment in strict accordance with manufacturer's recommendations and requirements of other Sections.

3.2 COORDINATION:

- A. Units installed on roof:
1. Roof decking shall remain inside of curb except for openings required for duct, controls and electrical power penetrations. Coordinate roof deck installation and cutting of openings with General Contractor. Pack annular space around duct and conduit penetrations with fiberglass insulation.
 2. Coordinate responsibility for providing equipment roof curbs and flashings with roofing contractor. Coordinate curb type with roofing contractor to ensure curb's compatibility with roofing system and with curb-mounted equipment.
 3. Coordinate electrical installation with electrical contractor so that all required conduit roof penetrations occur within the unit curb.
- B. Units installed on grade:

1. Coordinate concrete slab installation with General Contractor.
2. Install roof curb level and secured to concrete slab.
3. Provide sheet metal shroud as detailed on drawings, for all ductwork exposed outside of the building.

C. Electrical Connections:

1. Coordinate with other trades the complete electrical installation for all necessary final power and controls connections to equipment and loose shipped electrical components.
2. For rooftop installation, coordinate electrical installation with electrical contractor so that all required conduit roof penetrations occur within the unit curb.

3.3 DELIVERY, STORAGE AND HANDLING:

- A. Handle rooftop units and components carefully to prevent damage. Replace damaged rooftop units or components with new.
- B. Store rooftop units and components in clean dry place, off the ground and protect from weather, water, and physical damage.
- C. Rig rooftop units to comply with manufacturer's rigging and installation instructions for unloading rooftop units and moving them to final location.

3.4 EXAMINATION:

- A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.5 INSTALLATION:

- A. General: Install rooftop units in accordance with manufacturer's installation instruction. Install units plumb and level, firmly anchored in locations indicated and maintain manufacturer's recommended clearances.

3.6 DEMONSTRATION:

- A. Start-up Services: Provide the services of a factory authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

3.7 TESTING AND BALANCING:

- A. See Section 23 99 00.

3.8 SYSTEM VERIFICATION AND CALIBRATION:

- A. Make all repairs, adjustments and programming changes necessary to accomplish the desired operation of the HVAC systems.
- B. See MECHANICAL SYSTEM VERIFICATION AND CALIBRATION of Specification Section 23 01 00 for complete requirements.

END OF SECTION 23 65 10

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SECTION 23 80 00 - HVAC EQUIPMENT - AIR SIDE

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Furnish and install air-side heating, ventilating and air handling equipment of all types employed in the Project.

1.2 QUALITY ASSURANCE

- A. ISO 9001 Certification
- B. Unit designed and tested in compliance with ARI 430 air delivery ratings per ARI 430-1999.
- C. Unit designed and tested in compliance with ARI 260-2001.

1.3 REGULATORY REQUIREMENTS

- A. Unit shall be manufactured to conform to UL 1995 Standard and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to unit.

1.4 SUBMITTALS

- A. Submit unit performance data including: capacity, nominal and operating performance.
- B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.
- C. Submit shop drawings indicating overall dimensions as well as installation, operation and service clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
- D. Provide fan curves with specified operating point clearly plotted.
- E. Submit data on electrical requirements. Include safety and start-up instructions.
- F. See Section 23 01 00.

PART 2 - PRODUCTS

2.1 PACKAGED CEILING FANS:

- A. Packaged ceiling fans shall be factory assembled units including fan, motor, housing, prewired plug disconnect and discharge damper with capacities, arrangements and accessories as scheduled. Provide intake grille when installed in ceiling.
- B. Fan wheels shall be of the centrifugal type, direct connected to a permanently lubricated, radio shielded, thermally protected motor with neoprene torsion mounts to isolate vibration.
- C. Fan and motor shall be enclosed in a baked enamel steel housing suitable for horizontal or vertical discharge and ceiling or in-line installation. Housing shall be lined with 1/2-inch acoustical insulation.
- D. Intake grille (where required) shall be white aluminum or plastic and shall be removable for cleaning or service.
- E. Furnish necessary ductwork, transitions, eaves, wall or roof caps as scheduled and as required.
- F. Acceptable Manufacturers, - Acme, Carnes, Cook, Greenheck, Loren Cook, Penn.

2.2 BACKDRAFT DAMPERS:

- A. See Section 23 85 00.

2.3 EQUIPMENT MOTORS AND BEARINGS:

- A. See Section 23 01 00.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION:

- A. Install equipment in strict accordance with manufacturer's recommendations and requirements of other sections.

3.2 SPACE REQUIREMENTS:

- A. The Contractor shall field measure all existing clearances relative to receiving, transporting and installing equipment where indicated on the drawings. If necessary, the contractor shall

disassemble unit and reassemble in final installed position. Such disassembly and reassembly shall be approved by and carefully coordinated with the equipment manufacturer.

3.3 DELIVERY, STORAGE, AND HANDLING:

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Units shall ship fully assembled up to practical shipping and rigging limitations. Units not shipped fully assembled shall have tags on each section to indicate location and orientation in direction of airflow. Each section shall have lifting points to allow for field rigging and final placement of section.
- C. Store in a clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- D. Deliver units to site with fan motors, sheaves, and belts completely assembled and mounted in units. If these components are not completely assembled, contractor shall be responsible for all expenses associated with installation, testing, and vibration balancing of fan(s).

3.4 START-UP AND OPERATING REQUIREMENTS:

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters in place, bearings lubricated (if applicable), condensate properly trapped, piping connections verified and leak-tested, belts aligned and tensioned, all shipping braces removed, bearing set screws torqued, and fan has been test run under observation.

3.5 SYSTEM VERIFICATION AND CALIBRATION:

- A. See Section 23 01 00.

3.6 TEST AND BALANCE:

- A. See Section 23 99 00.

END OF SECTION 23 80 00

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SECTION 23 85 00 - DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide all necessary labor, equipment, and materials for a complete duct system, including all hardware and accessory devices.
- B. Install instrumentation devices in the duct system, furnished under Section 23 90 00.

1.2 STANDARDS:

- A. Ductwork shall be fabricated, erected and installed and fitted out with accessories in accordance with current editions of the following -
 - 1. Governing Building Codes.
 - 2. NFPA 90A.
 - 3. SMACNA HVAC Duct Construction Standards.

1.3 DEFINITIONS:

- A. Pressure - Velocity Classification - classifications of duct construction as defined in SMACNA HVAC Duct Construction Standards, First Edition, 1985 (Table 1-1).
- B. Insulated Ductwork - externally insulated as specified in Section 23 25 00.
- C. Preinsulated Ductwork - ductwork constructed of insulating material or incorporating insulating material during fabrication.

1.4 SUBMITTALS:

- A. Submit complete printed catalog and descriptive data for each major piece of equipment, clearly indicating exactly what features, options and accessories are being provided.
- B. See Section 23 01 00.

1.5 OPTIONS:

- A. Equivalent area round ducts may be substituted for rectangular ducts serving a single outlet provided the round duct tap is made into the rectangular with a round take-off fitting with integral volume damper as specified below.

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Galvanized steel sheets, lock-forming quality, ASTM A-525 with galvanized coating for both sides of the sheet.
- B. Black steel sheets - conforming to ASTM A-366.
- C. Aluminum base alloy sheets - conforming to ASTM B-209.
- D. Proprietary Flanged Transverse Duct Joint Assembly - Ductmate system, applied and installed in accordance with manufacturer's published recommendations.
- E. Duct Sealant - United, Foster, Hardcast, Minnesota Mining Manufacturing.

2.2 FLEXIBLE CONNECTIONS:

- A. Woven nylon, 22 oz./sq. yd., 150 lb. tongue tear strength, 500 lb. tensile strength, flame retardant coating, proof fabric maximum 10-inches long, minimum 4-inches in direction of air flow.
- B. Acceptable Manufacturers – Ductmate, Durodyne, Hardcast, Ventfabrics.

2.3 MOTORIZED DAMPERS:

- A. Louver type with not less than 16 gauge welded steel frames and galvanized finish. Blades shall have interlocking edges, vinyl or neoprene gaskets, and Teflon coated stainless steel thrust washers. Blades shall be edged with neoprene.
- B. Actuators shall be driven by electrically powered motors and shall be sized to operate their appropriate dampers or valves with sufficient reserve power to provide 2-position action. Provide adjustable positive stops or limit switches on each actuator.
- C. Acceptable Manufacturers - Air Balance, Carnes, Empco, Greenheck, Krueger, Louvers & Dampers, Ruskin.

2.4 BACKDRAFT DAMPERS:

- A. Provide heavy-duty shutter type dampers, with galvanized 16 gage or extruded aluminum frame and wind stops, minimum 28 gage galvanized steel or 26 gage aluminum blades, 3/16-inch steel shaft with "Oilite" bronze bearings, roll formed blade edged with felt sealer, blades linked with tie bar and adjustable counter weight, to allow full blade position parallel to air flow under full air flow with gravity closing of dampers on reverse flow.
- B. Provide frames for required mounting and access doors required for complete adjustment of balance weight.
- C. Fan manufacturer's backdraft dampers are acceptable where furnished and installed in conjunction with exhaust fan installations scheduled, and similar to above.

- D. Acceptable Manufacturers - Air Balance, Carnes, Empco, Greenheck, Krueger, Louvers & Dampers, Ruskin.

2.5 VOLUME DAMPERS:

- A. Provide manual balancing dampers with position locking mechanism as shown and as required to balance the air flow to each outlet or from each inlet.
- B. Construction in accordance with SMACNA manuals.

2.6 FLEXIBLE DUCT:

- A. Flexible duct shall be light weight duct formed with a resilient core of continuous, chlorinated polyethylene inner air barrier and insulated with resilient 1 1/2-inch thick fiberglass and jacketed with a tough scrim-reinforced aluminum vapor barrier and containing a totally encapsulated reinforcing wire helix.
- B. Listed as UL 181, Class 1 duct. Complies with NFPA 90A.
- C. Provide flexible duct clamps of self-locking nylon, or stainless steel with swivel action screw.
- D. Acceptable Manufacturers - Flexmaster, Thermaflex.

2.7 BRANCH DUCT TAKE-OFF:

- A. A round or rectangular take-off made from a rectangular supply, return or exhaust duct shall utilize a fitting having rectangular opening with 45° transition on main duct to round or rectangular collar on branch duct side of fitting. Fitting shall be equivalent to Wichita Sheet Metal Supply Co. model HETO.
- B. A round take-off from a round supply, return or exhaust duct shall utilize a fitting having round opening with 45° transition on main duct to round collar on branch duct side of fitting.
- C. Fitting shall include a butterfly damper with quadrant operator in branch duct collar, with stand-off platform to extend quadrant beyond duct wrap for insulated duct. Provide a wing nut at each end of damper shaft.

2.8 SHEET METAL HARDWARE:

- A. Quality and configuration to conform to Ventfabrics, Inc. Piece number and description, as listed-
 1. Ventfabrics No. 641 damper regulator, self-blocking, die- cast, secure to sheet metal on exposed and concealed ductwork above accessible ceilings.
 2. Ventfabrics No. 677 damper regulator, self-blocking die- cast, chrome plated cover. To control ductwork located above an accessible ceiling or confined in wall spaces. Control from conditioned space.

3. Ventfabrics No. 607 damper end bearing, die-cast for rectangular ducts, with bearing and opening for shaft inclusion.
4. Ventfabrics No. 609 end bearing, die-cast for cylindrical ducts, with suitable gaskets, bearing and recess for shaft insertion.
5. Ventfabrics No. 615 and 616 tandem placed U-bolts, with washer and nuts to fix damper rod to damper blade.
6. Ventfabrics No. 699 die-cast instrument test hole, with screw, cap and gasket.
7. Ventfabrics No. 611, 160 F. fusible link, 15 lb. load capacity.
8. Ventfabrics No. 613, 212 F. fusible link, 15 lb. load capacity.
9. Ventfabrics No. 90, sash lock, cadmium plated stamp steel construction, for use on reach-thru doors.
10. Ventfabrics No. 220, die-cast door pulls for use on reach- thru access doors.
11. Ventfabrics No. 150, 2 x 1-11/16-inch galvanized duct hinges, minimum 2 hinges per door, for use on reach-thru access doors.

B. Acceptable Manufacturers - Duro-Dyne, Ventfabrics, Inc., Young Regulator.

2.9 FABRICATION:

A. Ductwork -

1. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, latest edition.
2. Each duct system shall be constructed for the specific duct pressure of the system.
3. Pressure-Velocity Classification and seal class shall be as follows:
 - a. Supply, return and general exhaust ductwork shall be galvanized sheet metal constructed per requirements for the 2" water gage pressure class and seal class "C". Exposed make-up air duct to range hoods shall be stainless steel.
 - b. Kitchen hood exhaust duct shall be steel sheet with radius offsets, constructed per requirements for the 3" water gage pressure class. Concealed duct shall be fabricated from black steel, exposed duct shall be fabricated from stainless steel. All seams and joints shall be welded.
 - c. Dishwasher exhaust duct shall be stainless steel or aluminum with radius offsets, constructed per requirements for the 2" water gage pressure class. Concealed duct shall be fabricated from aluminum, exposed duct shall be fabricated from stainless steel. All seams and joints shall be sealed watertight with silicone.
4. Seal supply, return, and general exhaust ductwork with Hardcast #601 water based, UL listed sealant or approved equivalent, in accordance with SMACNA HVAC Duct Construction Standards for required static pressure construction class and seal class.

B. Rectangular duct fittings-

1. Elbows, tees and splits shall be constructed with square turns or radius turns which shall have a centerline radius 1-1/2 times the width of the duct as an absolute minimum.
2. If square turns are used, fabricate and install hollow formed turning vanes in each turn for elbows turns for elbows having equal inlet and outlet dimensions.
3. Where elbows have unequal inlet and outlet dimensions, turning vanes shall have leading and trailing edges parallel with the air flow and shall be high efficiency profile type similar to those manufactured by the Aerodyne Company. Vane assemblies shall be made with Aerodyne side rails, and vanes shall be installed on design centers as for the

vanes across the full diagonal dimension of the elbow. Cut center section of each rail as recommended by manufacturer so that the required position adjustment may be made.

- C. Round duct - Spiral seam, butt welded longitudinal seam, or snap lock seam.
1. Up to 12-inch: 26 gage steel spiral seam, or 26 gage steel butt welded longitudinal seam or snap lock seam, with 26 gage steel duct fittings.
 2. 13 thru 18-inch: 26 gage steel spiral seam, or 24 gage steel butt welded longitudinal seam or snap lock seam, with 24 gage steel duct fittings.
 3. 19 thru 28-inch: 24 gage steel spiral seam, or 22 gage steel butt welded longitudinal seam or snap lock seam, with 22 gage steel duct fittings.
 4. 29 thru 36-inch: 22 gage steel spiral seam, or 20 gage steel butt welded longitudinal seam or snap lock seam, with 20 gage steel duct fittings.
 5. 37 thru 52-inch: 20 gage steel spiral seam, or 18 gage steel butt welded longitudinal seam or snap lock seam, with 18 gage steel duct fittings.
 6. Joints-
 - a. Beaded sleeve joints on spiral duct, 1-inch minimum lap.
 - b. Beaded crimp joints, 1-inch minimum lap, 3 screws per joint.
 - c. Draw band joint, 4-inch minimum width, lap 2-inch over each section of duct, 2 draw bolts per joint, minimum.
 - d. Companion flange joint.
- D. Round ductwork fittings-
1. Each 90 degree elbow shall be 2-piece welded, die formed construction, and shall have a center-line radius of not less than 1.5 times the duct diameter.
 2. Each elbow between 45 and 90 degrees shall be 3-piece construction, with same center-line radius requirements.
 3. Provide combination lateral elbow and tee, 90 degree tees, conical tees, double wye's and reducers each as required.

2.10 GRILLES, REGISTERS AND DIFFUSERS:

- A. Provide as scheduled.
- B. Increase size when required for installation in lined ductwork.
- C. Air Distribution-
1. Supply units shall be designed to provide the throw and spread required with no apparent drafts or excessive air movements within the ventilated or air conditioned spaces.
 2. Provide air distribution accessories required to effect these conditions as part of the supply unit.
- D. Noise-
1. The noise spectrum of the supply units shall be no higher than N.C.-35 as defined in the latest issue of ASHRAE Guide.
 2. Units causing excessive air movement, drafts or objectionable noise shall be replaced at no cost to the Owner.
- E. Volume Control - Furnish supply outlets with key operated volume dampers, unless otherwise specified.

- F. Gaskets - Flanges of diffusers, registers and grilles shall be gasketed with foam rubber gaskets to prevent leaking and smudging.
- G. Finish - Furnish grilles, registers, and outlets in factory baked white enamel finish, also suitable as prime coat for finish painting in the field, except as otherwise specified or scheduled.
- H. Acceptable Manufacturers - Air Concepts, Anemostat, Barber- Colman, Buensod-Stacy, Carnes, Carrier, Conners, Krueger, Metalaire, Titus, Tempmaster, Trane, Tuttle & Bailey.

PART 3 - EXECUTION

3.1 MATERIAL APPLICATION:

- A. Galvanized steel sheets - use for fabrication of the following-
 - 1. Supply, return, exhaust ducts except as otherwise specified.
 - 2. Housings for coils, dampers, filters and fans.
 - 3. Volume control dampers.
 - 4. Intake and exhaust plenums, roof caps and goosenecks.
 - 5. Hangers for ducts.
 - 6. Flashing and counterflashing.
- B. Black steel sheets - use for fabrication of the following-
 - 1. Concealed kitchen hood exhaust duct.
- C. Aluminum base alloy sheets - use for fabrication of the following-
 - 1. Concealed dishwasher exhaust ducts.
- D. Stainless steel sheets - use for fabrication of the following -
 - 1. Exposed dishwasher exhaust and range hood supply or exhaust ducts.
- E. Pre-insulated, closed cell, outdoor ductwork – use for fabrication of the following –
 - 1. Supply and return ductwork installed outdoors.

3.2 DUCT SIZE AND ROUTING:

- A. Ductwork sizes and routing shown on drawings are schematic. Offset, flatten and maintain duct area, and reroute ducts where required to maintain headroom, clear light fixtures, pipes, conduits, structure and other construction.

3.3 INSTALLATION:

- A. Flexible connectors-
 - 1. Install on inlet and outlet of each piece of air handling equipment.
- B. Flexible duct-

1. Secure to duct, apply heat resistant fire retardant compound to male end of each piece of duct, insert into flexible duct, secure with draw in accordance with manufacturer's instructions.
 2. Flexible ducts shall have developed length of not more than 4-feet and be supported to eliminate sagging and afford smooth 1-1/2 center-line (minimum) bends.
 3. Flexible duct shall not be installed above inaccessible ceilings or in other concealed locations.
- C. Volume dampers-
1. Install at each split in each run of duct.
- D. Sheet metal hardware-
1. Install as required and in accordance with manufacturer's recommendations.
- E. Air devices-
1. Each air outlet of each duct system shall be equipped with a balancing damper, either integral with the device or located in the individual branch duct to balance the airflow from that device.
 2. These devices shall be installed after the duct systems are thoroughly cleaned, with suitable accessories as specified or required for proper air distribution.
- F. Automatic dampers -
1. Install automatic dampers except dampers specified as integral parts of factory fabricated air handling unit components.
- G. Dishwasher exhaust -
1. Seal all seams and joints watertight with silicone and pitch at a minimum of 1/4-inch per foot to drain toward the hood connection or the "soiled" dishwasher connection, as applicable.
 2. All changes in direction shall be made with radius elbows.
- H. Range hood exhaust -
1. Weld all seams and joints watertight, pitch at a minimum of 1/4-inch per foot to drain toward the hood connections, and provide access doors in vertical faces, turning vanes are prohibited. Ducts shall either be enclosed in fire rated shaft construction by the General Contractor or wrapped with scheduled insulation, see plans and coordinate with General Contractor.
 2. All changes in direction shall be made with radius elbows.
- I. Pre-insulated, closed cell, outdoor ductwork –
1. Ducts shall be detailed and fully factory manufactured by a manufacturer- authorized facility.
 2. Fabrication:
 - a. Fabricated joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to manufacturer's written and detailed instructions.
 - b. Fabricated 90-degree mitered elbows to include turning vanes.
 - c. Fabricated duct segments in accordance with manufacturer's written details.

- d. Duct Fittings shall include 6 inches of connecting material, as measured, from last bend line to the end of the duct. Connections on machine manufactured duct may be 4 inches.
 - e. Fabricated duct segments utilizing v-groove method of fabrication. Factory welded or cohesively bonded seams will apply to fully manufactured ductwork and fittings. Internal seams will be supplied with an unbroken layer of low VOC silicone or bonding (for paint shop applications). Each duct segment will be factory supplied with either aluminum grip pro-file or pre-insulated duct connectors in accordance with manufacturer's detailed submittal guide. Applied duct reinforcement to protect against side deformation from both positive and negative pressure per manufacturer's design guide based on specified ductwork size and system pressure.
 - f. Designed and fabricated duct segments and fittings will be in accordance with "SMACNA Duct Construction Standards" latest edition.
 - g. Both positive and negative ductwork and fittings shall be constructed to incorporate a UL Listed as a Class 1 air duct to Standard for Safety UL 181 liner with an exterior clad for permanent protection against water intrusion.
 - h. Duct shall be constructed to exceed requirements for snow and wind loads.
3. Duct segments shall be installed by competent HVAC installers.
 4. Install ducts and fittings to comply with manufacturer's installation instructions as follows:
 - a. Install ducts with fewest possible joints.
 - b. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
 - c. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - d. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
 - e. Use prescribed duct support spacing as described in this specification and manufacturer's recommendations.
 5. Air Leakage: Duct air leakage rates to be in compliance with "SMACNA HVAC Duct Construction Standards" latest version per applicable leakage class based on pressure.
 6. Contractor to ensure that the ductwork system is properly and adequately supported.
 - a. Ensure that the chosen method is compatible with the specific ductwork system requirements per manufacturer's installation detail drawings. Pre-installation should be provided prior to work commencement by installing contractor for approval. .
 - b. 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.
 - c. Supports on straight runs of ductwork shall be positioned at centers not exceeding 13 feet for duct sections when fabricated in 13 foot lengths with duct girth less than 84". Larger duct sizes and short segments with duct girth greater than 84" are to be supported at 8 foot centers or less, in accordance with the manufacturer's installation details provided prior to work commencement.
 - d. Ductwork shall be supported at changes of direction, at branch duct connections, tee fittings, parallel under turning vanes and all duct accessories such as dampers, etc.

- e. The load of such accessories to the ductwork shall be neutralized by the accessory support.
7. Inspection: Arrange for manufacturer's representative to inspect completed installation and provide written report that installation complies with manufacturer's written instructions.
 - a. Remove and replace duct system where inspection indicates that it does not comply with specified requirements.
 - b. Perform additional testing and inspecting, at the Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.4 ERECTION:

A. Hangers-

1. Provide round hangers, strap hangers, or trapeze shelf hangers in accordance with SMACNA standards.
2. Rectangular ducts 0 thru 47-inches wide, use 18 gage galvanized strap, 10 feet on center, 1-inch strap.
3. Rectangular ducts 48-inches and wider, use trapeze hangers formed of angle iron under duct rigidly and securely supported to building structure by threaded rods, installed per SMACNA standards.
4. Cylindrical ducts - 0 thru 36-inches in diameter, use 18 gage galvanized strap, 10 feet on center, 1-inch strap.
5. Cylindrical ducts over 37-inches in diameter, use 16 gage galvanized strap, 10 feet on center, 2-inch strap.
6. For vertical ducts - 0 thru 24-inches in any dimension, use 1 x 1 x 1/8-inch galvanized angle. Secure angle to duct at each floor level, rest angle on building structure.
 - a. Ducts 25-inches thru 60-inches use 1 1/2 x 1 1/2 x 3/16-inch galvanized angle.
 - b. Ducts over 61-inches use 2 x 2 x 3/16-inch galvanized angle.
 - c. Support to the building construction and secure to duct.
7. For cylindrical, double wall ducts, refer to drawings and SMACNA standards.
8. Support flexible ducts with 18 gage, 1-inch wide galvanized straps, with span lengths as short as necessary to prevent sagging.

3.5 ACCESS DOORS:

- A. Provide duct access doors as required to clean kitchen hood exhaust ductwork. In other ducts, provide duct access doors as required to service each item of equipment mounted in the ductwork, including but not limited to-
 1. Fire and combination fire/smoke dampers.
 2. Automatic control dampers.
 3. Coils.
 4. Volume dampers.
 5. Filters.
 6. Controls devices.

- B. Duct access doors shall be complete with latches, gaskets and frames, and shall be constructed in accordance with SMACNA manuals. Provide hinged doors wherever practicable, removable type otherwise. Access doors in insulated ducts shall be insulated.
- C. Furnish access doors as specified in Section 23 01 00 for installation in the general construction wherever duct access doors would not otherwise be accessible.
- D. Access doors shall be generously sized for the purpose intended. Demonstrate suitability of each to the satisfaction of the Architect.

3.6 TESTING:

- A. Mechanical contractor shall test grease hood exhaust duct in accordance with the requirements of the 2006 International Mechanical Code. The duct shall be tested for leakage and liquid tightness, prior to concealment or insulating of any portion of the duct system.
- B. See Section 23 99 00 for additional testing requirements.

3.7 COMPLETION:

- A. Complete each entire duct system, perform testing and cleaning operations, and leave each system in a condition with the coils cleaned, the filters clean, and debris and foreign material removed from the duct system.
- B. Install a suitable air diffuser, grille, or similar device to cover each duct outlet.
- C. Paint bare metal interior surfaces of ducts which can be seen through air inlets or outlets with a flat black paint.
- D. Operate system and prove them to be free from excessive noise, free from perceptible air leaks, free from vibration, and capable of delivering the air quantities scheduled.

END OF SECTION 23 85 00

SECTION 23 99 00 - TESTING, ADJUSTING AND BALANCING (HVAC)

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. This Section applies to the testing, adjusting, and balancing of all HVAC air and water systems in Divisions on 23 of the Specifications. Services shall include checking installations for conformity to design, measurement and establishment of fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- B. The mechanical contractor shall perform system cleaning, testing and start-up before commencement of the test and balance work.

1.2 QUALIFICATIONS:

- A. Testing, adjusting and balancing (T-A-B) of systems shall be performed by a competent and experienced personnel, certified by the Associated Air Balance Council or National Environmental Balancing Bureau in those testing and balancing disciplines required for this project, having done similar work in the past, and whose qualifications shall be subject to approval.

1.3 SUBMITTALS:

- A. Submit names and qualifications of all persons proposed for testing, adjusting and balancing of mechanical systems and equipment. T-A-B work shall not begin until approval of such submittal is obtained.
- B. Submit report format as described below. T-A-B work shall not begin until approval of such submittal is obtained.
- C. See Section 23 01 00.

1.4 REPORTS:

- A. Provide reports and certificates required in each category of testing, adjusting and balancing, signed both by the technician performing the work and the Contractor as representing accurate, factual data, based on readings on the job. Include a listing of the instrumentation used for the procedures along with proof of instrument calibration. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- B. Reports shall be submitted on 8-1/2 x 11-inch paper format. Submit format for recording data for approval prior to use. Include a copy of final reports in each Operating and Maintenance Manual.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS:

- A. Provide all meters, instruments, equipment and materials necessary for performance of tests.
- B. Testing apparatus, not part of the permanent installation, shall remain the property of the Contractor.
- C. Provide gaskets, lubricants, and other expendable materials required to be replaced during the execution of this work.
- D. Fixed-pitch pulleys required for fan adjustments shall be provided on an exchange basis by the party responsible for the equipment installation (applies to new equipment only).

PART 3 - EXECUTION

3.1 MECHANICAL CONTRACTOR RESPONSIBILITIES PRIOR TO COMMENCEMENT OF TEST AND BALANCE WORK:

- A. Clean all dirt and debris from equipment.
- B. Service all bearings, gear boxes, wearing surfaces and other equipment components requiring lubrication as recommended by the equipment manufacturer.
- C. Check all motor driven equipment for proper rotation.
- D. Tag all valves and label all equipment.
- E. Clean all plenums and ductwork.
- F. Perform start-up on all equipment to insure proper operation.
- G. Replace air filters.
- H. Check all refrigerant systems to insure that they are properly charged with refrigerant and oil, and that they are moisture free.
- I. Check all control devices to insure that they are installed correctly and are operating properly.
- J. Make preliminary settings and adjustments as required to insure all systems will operate satisfactorily while test and balance work is performed.
- K. Provide a set of final shop drawings to the test and balance agency.

- L. Furnish and install additional balancing valves, dampers, test plugs and gauge cocks if the test and balance agency determines that such additional items are required to properly balance the systems.

3.2 TEST AND BALANCE PERSONNEL RESPONSIBILITIES PRIOR TO COMMENCEMENT OF TEST AND BALANCE WORK:

- A. Obtain design drawings, specifications, and submittals of mechanical equipment and temperature control diagrams, and become thoroughly acquainted with the design intent.
- B. Walk the systems to become familiar with equipment locations and to determine variations of the installation from design.
- C. Prepare schematic diagrams of ductwork and piping systems as installed to facilitate reporting.
- D. Prior to beginning of testing, adjusting and balancing procedures, schedule and conduct a conference with the Engineer and representatives of the installers of the mechanical and temperature control systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.
- E. Schedule testing, adjusting and balancing procedures so that air conditioning systems are balanced during summer season and heating systems are balanced during winter season, including at least a period of operation at outside conditions within 5° F wet bulb of maximum summer design condition, and within 10° F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

3.3 MECHANICAL CONTRACTOR RESPONSIBILITIES DURING TEST AND BALANCE WORK:

- A. The mechanical contractor shall cooperate and assist the test and balance personnel in performing the test and balance work. He shall also provide craftsmen and/or technicians of the various trades as required to assist the test and balance agency in performing the test and balance work. The craftsmen and/or technicians provided shall be familiar with the installed systems.

3.4 TEST AND BALANCE PERSONNEL RESPONSIBILITIES DURING TEST AND BALANCE WORK:

- A. Provide temperature controls contractor with temperature, pressure and flow measurements as required for the calibration and verification of temperature controls system operation.
- B. Perform testing, adjusting and balancing procedures for the various systems as described herein and in accordance with applicable standards of the National Environmental Balancing Bureau, Associated Air Balance Council, and the American Society of Heating and Refrigeration Engineers 1991 Handbook, Chapter 34.

3.5 SYSTEM VERIFICATION AND CALIBRATION:

- A. Provide attendance by a qualified technician to work in cooperation with other participants to calibrate, integrate, and verify operation of all components and equipment described in this work.
1. Make all repairs, adjustments and programming changes necessary to accomplish the desired operation of the HVAC systems.
 2. See MECHANICAL SYSTEM VERIFICATION AND CALIBRATION of Specification Section 23 01 00 for complete requirements.

3.6 HEATING, VENTILATING AND AIR CONDITIONING SYSTEMS:

Note - items marked TBA shall be the responsibility of the Test and Balance Agency; items marked MC shall be the responsibility of the Mechanical Contractor.

1. TBA - Balance all new or existing supply and exhaust air systems in accordance with SMACNA and AABC standards, by the use of a direct reading instrument such as "Anemotherm" or "Velometer" which has been properly calibrated.
2. TBA -The quantity of airflow at each inlet or outlet shall be within 10 percent of the design cfm shown on the Drawings.
3. TBA - Blank-off sufficient filter area to simulate a dirty filter condition (maximum pressure drop across filter bank).
4. For variable volume systems, furnish typewritten data for both maximum cooling and maximum heating air delivery, tabulating –
 - a. Quantity of air in cfm at each air supply outlet.
 - b. Dry bulb temperature of the supply air.
 - c. Outdoor dry and wet bulb temperature at the time the above tests are conducted.
5. TBA - Furnish typewritten data tabulating-
 - a. Quantity of air in cfm at each air outlet and inlet.
 - b. Dry bulb temperature in each room.
 - c. Dry bulb temperature of the supply air.
 - d. Outdoor dry and wet bulb temperature at the time the above tests are conducted.
6. MC - Adjust belts, sheaves and the alignment of air handling equipment.
7. MC - Where various combinations of sheaves must be installed on fan systems to achieve the correct air delivery, change the sheaves and continue to take successive readings until the correct combinations are installed.
8. MC - Oil or grease bearings in accordance with manufacturer's instructions.
9. TBA -Furnish typewritten data taken at each air handling unit, for both clean and dirty filter conditions, tabulating-
 - a. Total quantity of supply air in cfm.
 - b. Total quantity of return air in cfm.
 - c. Total quantity of outside air in cfm.
 - d. Rpm of each fan or blower.
 - e. Rpm of each motor.
 - f. Voltage and ampere input of each motor (one reading for each phase leg on 3 phase motors).
 - g. Pressure in inches water gage at inlet and discharge of each fan or blower.
 - h. Furnish manufacturer's fan curve with calculated operation condition shown thereon.

10. TBA - Furnish air handling unit test data for variable volume systems at both maximum system air delivery and maximum turn-down.
- B. Outside/Return Air Mixing Chambers-
1. TBA, Test each outside/return air mixing chamber for air handling units to prove actual air mixture conditions as specified. Balance return and outside air quantities for mixing plenums to the flows specified.
 - a. TBA, Outdoor temperature at the time the above tests are conducted.
- C. Rooftop Heating/Cooling Outside Air Supply Units -
1. MC, Adjust, align and service rooftop units in accordance with manufacturer's recommendations and as required to achieve proper operation. Oil or grease bearings in accordance with manufacturer's instructions. Adjust belts and sheaves. Where various combinations of sheaves must be installed on fan systems to achieve the correct air delivery, change the sheaves and continue to take successive readings until the correct combinations are installed.
 2. Furnish typewritten data for each system, for both clean and dirty filter conditions, tabulating-
 - a. MC, Suction and condensing temperatures, and pressures.
 - b. TBA, Temperatures of entering and leaving condenser air.
 - c. TBA, Ampere input of compressor motors under full load (for each phase leg).
 - d. TBA, Rpm of each condenser fan and motor.
 - e. TBA, Rpm of each condenser fan and motor.
 - f. TBA, Quantity of supply air in cfm.
 - g. TBA, Quantity of exhaust air in cfm.
 - h. Entering and leaving supply air dry bulb and wet bulb temperature for supply air and exhaust air stream through energy recovery media.
 - i. TBA, Evaporator face velocity in fpm.
 - j. TBA, Evaporator entering and leaving dry and wet bulb temperature.
 - k. TBA, Total quantity of supply air in cfm.
 - l. TBA, Total quantity of return air in cfm.
 - m. TBA, Total quantity of outside air in cfm.
 - n. TBA, Rpm of each supply fan or blower.
 - o. TBA, Rpm of each supply fan motor.
 - p. TBA, Voltage and ampere input of each fan motor (one reading for each phase leg on 3 phase motors).
 - q. TBA, Pressure in inches water gage at inlet and discharge of each supply and exhaust fan or blower.
 - r. TBA, Heat exchanger entering and leaving dry bulb temperature.
 - s. TBA, Outdoor temperature at the time the above tests are conducted.
- D. Exhaust Fans -
1. MC, Adjust, align and service exhaust fans in accordance with manufacturer's recommendations and as required to achieve proper operation. Oil or grease bearings in accordance with manufacturer's instructions. Adjust belts and sheaves. Where various combinations of sheaves must be installed on fan systems to achieve the correct air delivery, change the sheaves and continue to take successive readings until the correct combinations are installed.
 2. TBA, Furnish typewritten data for each exhaust fan, tabulating-

- a. Total quantity of exhaust air in cfm.
- b. Rpm of fan.
- c. Rpm of motor.
- d. Voltage and ampere input of fan motor (one reading for each phase leg on 3 phase motors).
- e. Pressure in inches water gage at inlet and discharge of fan.

END OF SECTION 23 99 00

SECTION 25 90 00 - TEMPERATURE CONTROLS**PART 1 - GENERAL****1.1 SCOPE:**

- A. Provide a complete and operating fully functional Building Control System (BCS) of electronic digitally processed temperature control system with energy management and monitoring functions for the building HVAC equipment and other systems included as part of the work for this Division.
- B. The controls specified in this section will be an expansion of the existing Johnson Controls Inc. system already serving the existing building.
- C. The BCS shall be comprised of a series of BACnet compliant digital controllers and sensors and network extension to connect to the existing control and energy management system. Provide additional programming, adjustment, and/or configuration of the system administrative software to provide user monitoring and operation of the HVAC equipment consistent with the existing user interface..
- D. Electric controls and mechanical devices for all HVAC items indicated on drawings, required for implementation of the operating sequences and as described hereafter including electronics, dampers, valves, wiring, interface devices and panels.
- E. A communications network to allow data exchange from each electronic controller to each other, controllers to user interface units and to a main user interface personal computer. Provide all interface components, routers, bridges, switches, hubs, modems and like communications equipment necessary for full access of the BCS network to the building operator.
- F. Installation, check out and calibration of all control devices and systems including HVAC equipment manufacturer supplied control devices supplied by this Division and all other HVAC controls supplied under this contract.
- G. Provide all software tools for installation, operation, modification and adjustment of control programs and electronic controller resident firmware settings. Provide licenses for all software residing in the BCS and user interface and transfer these licenses to the Owner prior to completion.
- H. The requirements of Section 23 01 00, Basic Mechanical Requirements, apply to this work.

1.2 RESPONSIBILITY:

- A. This Contractor shall be responsible for the complete installation of the control systems for all electrical equipment, including all power supply and control signal wiring and ancillary equipment necessary to provide a complete and fully operative control system as herein

specified. Where required by applicable codes, this contractor shall provide the services of a licensed electrician to complete this work.

- B. Any electrical installation not specifically indicated on the electrical plans shall be the responsibility of this contractor.
- C. All indications or notations of specific field points and equipment components are intended to represent a subset of the complete hardware and requirements for this work. Provide all hardware, software, wiring and pneumatic installation required for a complete system with fully functional operation as described herein.
- D. Provide all required control equipment, circuitry, interface and connections for smoke control implemented by HVAC equipment and components. Refer to drawings and control sequences for other related information.

1.3 ACCEPTABLE MANUFACTURERS:

- A. Johnson Controls, Inc.

1.4 QUALITY ASSURANCE:

- A. Installer:
 - 1. This system shall be engineered, installed, started and calibrated by a factory authorized and currently certified supplier.
 - 2. Installer shall have a minimum of five years experience in the installation of temperature control systems of similar size and scope.
- B. Design Criteria: Proposed substitutions shall be submitted in accordance with procedures outlined elsewhere in this Specification.
- C. The system shall be installed by competent mechanics, regularly employed by the controls manufacturer with full responsibility for proper operation of the system including debugging and calibration of each component in the system.

1.5 SUBMITTALS:

- A. Shop Drawings: Submit in accordance with other sections of this Specification. Indicate construction materials, sizes, capacities, quantities, and related hardware requirements.
- B. Instructions: Furnish Owner with Instruction Manual describing operation of temperature control system in accordance with other sections.
- C. Submit the following for each control system:
 - 1. System architecture showing all digital devices and interconnection.
 - a. A complete field points list shall be included.

2. Data sheets of all products
 3. Valve, damper and well and tap schedules showing size, configuration, capacity, pressure drop and location of all equipment.
 4. Data forms for identification of initial and user adjustable parameters.
 5. Equipment lists of all proposed devices and equipment.
 6. Software design data including:
 - a. Sequence of operation relating to all flowchart functions.
 - b. List of all programmed alarm points with proposed initial alarm threshold setpoints.
 7. Written commissioning and checkout procedure for each control system.
 8. Submit maintenance brochures after completion of the work. The maintenance brochure shall include operating instructions, specifications, and instruction sheets for each instrument, and a complete set of record drawings.
- D. Submittal shall also include a control network schematic diagram depicting connected devices and a description of the communication type and media.
1. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system expansion with minimal infrastructure modifications.
- E. Upon completion of the work, provide a complete set of 'as-built' drawings and application software on compact disk. Drawings shall be provided as AutoCAD™ compatible files. Eight copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk. Mechanical and Electrical contractors shall provide as-builts for their portions of work. This contractor shall be responsible for as-builts pertaining to overall BCS and FMS architecture and network diagrams. All as-built drawings shall also be installed into the FMS server in a dedicated directory.
- F. See Section 23 01 00 for additional submittal requirements.

1.6 COORDINATION:

- A. Manufacturer shall be responsible for details and dimensions not controlled by job conditions and shall show on his shop drawings required field measurements beyond his control. Coordinate with responsible trades to establish, verify, and maintain field dimensions and job conditions.
- B. Consult with other trades in advance and make provisions for their work to avoid cutting and patching.
- C. Where control system components interface to mechanical equipment or internal controls this Contractor shall be responsible for signal conversion, adjustment or configuration so as to conform to the equipment manufacturers' strictest requirements. Provide all hardware, software, wiring and installation required.

PART 2 - PRODUCTS**2.1 LOCAL CONTROL PANELS:**

- A. Provide standard cabinets. Controllers, relays, switches, terminal strips, interface devices, time clocks and similar devices except limit and safety controllers shall be located inside fully enclosed painted steel cabinets equipped with grounding backboards. Equipment room panels shall have hinged doors and shall also contain all power supplies, load relays, transducers, and associated equipment.
- B. All panel electronics, discrete control components and interface devices shall be installed in suitable enclosures. Groups of devices serving a single air unit or equipment system within a single room shall be installed in the same enclosure.

2.2 ELECTRIC SYSTEM DEVICES:

- A. All electric switch devices shall be selected for the applied load and UL listed for the application. All water thermostats shall be provided with a separate copper, monel or stainless steel well.
- B. All automatically controlled devices, unless specified otherwise, elsewhere, shall be provided with electric actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two position action and tight close-off. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
 - 1. Where two or more actuators are to be operated in sequence with each other, sequencing shall be by signal sequencing with separate analog outputs.
- C. Provide transducers, 2-position relays, sequencing relays, and other controls necessary to comply with the scheduled control sequences and provide for properly operating the automatic control system.
 - 1. Relays shall have C isolated contacts rated for 1.5 load amperes and horsepower if switching power supply to a motor.
- D. Provide low voltage power supplies and/or transformers where required for supplied component operation. Power supply devices shall be installed in enclosures with fusing and disconnecting means. All power supply equipment associated with an electronic controller shall be monitored by the digital control system. An input shall be utilized to sense operation of the power supply. If the supply fails a system alarm shall be generated.

2.3 DATA INPUTS AND OUTPUTS:

- A. Input/output sensors and devices shall be closely matched to the requirements of the remote panel for accurate, responsive, noise-free signal input/output. Control input response shall be

high sensitivity and matched to the loop gain requirements for precise and responsive control. In no case shall computer inputs be derived from pneumatic sensors or thermocouples.

- B. Temperature sensors shall be precision thermistors or resistance temperature detector type with high thermal resistive coefficients for the range to be measured.
 - 1. Space temperature sensors shall be provided with blank commercial type locking covers. Covers for air zones shall have external setpoint adjustable knob scaled and calibrated in degrees F and override buttons.
 - 2. Space humidity sensors shall be integrated into the space temperature sensor enclosures.
 - 3. Duct temperature sensors shall be rigid stem (12 inches minimum) or averaging type (20 feet minimum) as specified in the sequence of operation. Water sensors shall be provided with separable copper, monel or stain less-steel well.
- C. Relative humidity sensors shall be capacitance type with 10% to 90% range. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with covers identical to temperature sensors.
 - 1. Room humidity and temperature sensors shall be mounted in wall or ceiling mounting brackets with removable brushed stainless covers specifically design for finished space applications. Sensor enclosures shall be of minimum size required.
 - 2. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
- D. Current sensing switches shall be adjustable from 0.2 to 20 amperes or a higher range where applicable with 5% repeatability. Set current switches to release at a level between a normally loaded condition and unloaded condition so that a lost coupling or belt occurrence is detectable. For two-speed motorized equipment calibrate and test to detect operation of equipment at lowest speed.
- E. Control relays and analog output transducers shall be compatible with electronic controller output signals. Relays shall be suitable for the loads encountered.

2.4 BCS CENTRAL HARDWARE:

- A. For the system interface provide all required hardware, software, programming and interface equipment needed to permit full system communication and operation with the existing building control system.
- B. Provide system PC with all hardware, software and programming necessary for system operator interface and system control at the site.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install complete a control system including: Wiring, thermostats, controllers, sensors, transducers, control operators, transformers, relays, switches and other necessary devices.
- B. Provide complete systems to accomplish the indicated sequence of operation.
- C. Provide wiring and components for limiting, timing and interlocking required for safe operation of controlled equipment in accordance with manufacturers' recommendations.
- D. Install all control components in strict accordance with manufacturer's recommendations.
- E. All room thermostats, temperature and humidity sensors shall be installed 4'- 0" A.F.F. unless otherwise noted.
- F. The Building Control System (BCS) shall be designed, installed, and commissioned in a turnkey, fully implemented and operational manner including all labor and materials required for the completion of these systems and not noted in other sections of these specifications.
- G. All wiring shall be properly supported and run in a neat and workmanlike manner. All wiring in finished areas with exposed structure shall be installed in conduit. ALL WIRING AND RACEWAYS SHALL BE ATTACHED TO THE BUILDING STRUCTURE AND ROUTED ABOVE THE BOTTOM OF THE STRUCTURAL COMPONENTS. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All control circuitry shall have independent support from other building systems.
- H. The BCS contractor shall be responsible for all electrical installation required for a fully functional control system and not required by the electrical plans and specifications as Division 26 work. All wiring shall be in accordance to all local and national codes. All line voltage wiring, all wiring exposed in finished areas shall be installed in conduit and in accordance to the electrical specifications. All electronic wiring shall be #18 AWG minimum, plenum rated cable and shielded if recommended by the manufacturer for the application. All wiring in the mechanical rooms shall be installed in an approved manner.
- I. The BCS contractor shall enter all computer programs and data files into the related computers including all control programs, initial approved parameters and settings, and English descriptions.
 1. The BCS contractor shall maintain CD ROM copies of all data file and application software for reload use in the event of a system crash or memory failure. One copy shall be delivered to the owner during training session, and one copy shall be archived in the BCS contractor's local software vault.
- J. Provide modifications to software throughout the warranty period to accommodate the mechanical systems behaviors observed in real life operation and the Owner's determination of optimal scheduling and system sequences.

3.2 SEQUENCE OF OPERATION: See drawings for equipment specific control sequences.

- A. Sensor monitoring:

1. Alarm the failure of any system sensor by comparison against normal high and low limits of sensed variable. Provide user adjustable threshold setpoints for all alarm levels.

B. Alarms

1. Alarms, general:
 - a. Loss of signal - all system inputs.
 - b. Failure of all sensors.
 - c. Failure of all system controller communications.
 - d. Failure to start all motorized and heating equipment.
 - e. Failure to start all fans and pumps.
 - f. Loss of status with run command.
 - g. All system temperatures - outside of operating limits.
 - h. All system pressures – outside of limits.
 - i. Rapid cycling of any equipment.
2. Other equipment alarms:
 - a. Alarm from manufacturer control panel (i.e. sewage ejector panel).
 - b. LonWorks or Bacnet interface transmitted failure or alarm.
 - c. Smoke detector activation where applied for fan control.
3. Intelligent alarm function:
 - a. Where cycling of threshold variable is expected during normal sequencing (i.e. low pressure during fan wind-up) alarm function shall incorporate adequate time delay or other applicable discrimination logic to avoid nuisance alarms.

C. Monitoring system operation:

1. Provide trend logs of the system data and store data on the Facility Management System server.
2. Record every 15 minutes:
 - a. All temperature sensor points.
 - b. All room temperature sensor setpoints.
 - c. All humidity sensor data
3. Record change of state:
 - a. All smoke detector alarms.
 - b. All fan status.
 - c. All compressor run status.

3.3 FAIL-SAFE OPERATION:

- A. Control operators shall be selected, applied and installed in such a manner that upon a local power failure, the "normal" position of each operator shall be such that no physical damage will

be caused to any equipment as a result of loss of control power or electrical power to control devices or the entire unit.

- B. Power Fail / Auto Restart: Provide for the automatic orderly and predefined shutdown of parts or all of the BCS following total loss of power and loss of power to portions or of the BCS. Provide for the orderly and predefined scheduling of controlled equipment to return to normal, automatically time scheduled, operation as a result of the auto restart processes.
- C. Maintain the BCS real-time clock operation during periods of power outage for a minimum of 72 hours.

3.4 Alarms:

- A. Sensor monitoring: Alarm the failure of any system sensor by comparison against normal high and low limits of sensed variable.
 - 1. Each room temperature sensor shall have an associated alarm with separate alarm levels for occupied periods and unoccupied periods.
 - 2. Each room humidity sensor shall have an associated alarm with separate alarm levels for occupied periods and unoccupied periods.
- B. Provide alarm reporting and functionality consistent with the existing system functions.
- C. Alarms shall be functionally intelligent so that high or low sensed levels will not be alarmed when the associated equipment or system is not active. i.e. water temperature shall not be alarmed when the associated pumps are off and shall be delayed to allow the starting system to 'catch up' and gain control of the sensed variable.

3.5 SOFTWARE CUSTOMIZATION:

- 1. Provide customization of front end software to facilitate user operation and maintenance of controlled equipment.
- 2. Provide simple one-step means of implementing manual start/stop of each HVAC equipment item. Each equipment item shall be equipped with a manual override feature with a user defined time period.
- 3. Manual control of selected equipment items or systems shall automatically initiate start up of other required systems to permit selected equipment operation. (i.e. If an fan coil is selected for off hours operation the chilled water pump will start automatically.)
- 4. Provide display reports for each mechanical equipment item and HVAC system. Each report shall display all sensed data points, system output statuses, setpoints, system variables and other relevant data.
- 5. Provide displays that identify setpoints for all like equipment. Provide a display for each group of equipment units.
- 6. Provide displays that facilitate user adjustment of all setpoints for each equipment item, each HVAC system or each similar equipment group.

3.6 VALIDATION:

- A. The BCS contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the specifications and sequence of operations submitted.

3.7 ADJUSTING:

- A. Adjust and place entire system in operation. Provide readjustment necessary to accomplish specified results during the guarantee period.
- B. All setpoints, reset schedules, time delays, gain factors, span constants, etc. shall be adjusted by testing operation of the air and water handling systems and logging results.
- C. Coordinate calibrating efforts with the project test and balance agency for verification of temperatures, pressures and flows. Include system adjustment operation logs in the O & M Manuals.
 - a. Coordinate sequencing of compressorized equipment with equipment manufacturer recommended operation and time delays.
 - b. Provide all safeties and operating limits recommended by equipment manufacturers.
- D. Corrective software modifications shall be made during the check-out and start-up periods. Software parameters and entire algorithms shall be updated or replaced to optimize the operation of building equipment and system effectiveness. All software tuning and adjustment shall be made in close coordination with the equipment supplying contractors and the equipment manufacturers to ensure proper operation. Record all changes and update all user documentation and on user and manufacturer archived software disks.
- E. Provide adjustments and changes to control software requested by Owner after one year (all seasons) of operation. This programming service shall be provided under the system construction warranty. The contractor shall notify the Owner and request changes and implement prior to completing the warranty period.

3.8 TRAINING:

- A. All training shall be by the BCS contractor and shall utilize specified manuals and as-built documentation. See list of required documentation below.
- B. Following the completion of work, the Owner's representative shall be given a minimum of (2) two hour sessions of instructions on operation and maintenance of the completed system. Training topics shall include:
 - 1. Sequence of Operation review
 - 2. Selection of all displays and reports
 - 3. Troubleshooting software
- C. After the one year warranty period provide a scheduled training review session for one half day. Coordinate this session with the Owner's schedule so that he may arrange attendance by appropriate staff.

3.9 SYSTEM VERIFICATION AND CALIBRATION:

- A. See Section 23 01 00.

3.10 WARRANTY:

- A. All components, system software, parts and assemblies supplied by the BCS contractor shall be guaranteed against defects in materials and workmanship for one year from acceptance date.
- B. Labor to troubleshoot, repair, reprogram, or replace system components shall be furnished by the BCS contractor at no charge to the owner during the warranty period.
- C. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

3.11 DOCUMENTATION:

- A. An Operators Manual shall be provided with graphic explanation of keyboard use for all operator functions specified under Operator Training.
- B. A manual shall be provided including revised as-built documents of all materials required under the paragraph "SUBMITTALS" on this specification.
- C. Two Operators Manuals and four As-Built Manuals shall be provided to the owner.

END OF SECTION 25 90 00

SECTION 26 01 00 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL:

- A. All work covered by this section of these specification shall be accomplished in accordance with the respective drawings, information or instructions to bidders, general requirements, and the general conditions of these specifications. Any supplementary conditions, special conditions, addenda, or directives which may be issued by the Architect herewith or otherwise shall be complied with in every respect.
- B. Bidders shall determine the contents of a complete set of drawings and specifications and be aware that they may be bidding from a partial set of drawings, applicable only to the various separate contracts, sub-contracts, or trades as may be issued for bidding purposes only. The complete scope of work for the electrical trade in this project are illustrated on the complete Contract Documents which consist of the combined Architectural, Structural, Plumbing, Heating, Ventilating, and Air Conditioning plans and specifications. Each Bidder shall thoroughly acquaint himself with all the details of the complete set of drawings and specifications before submitting his bid. All drawings and specifications form a part of the contract documents for each separate contract and shall be considered as bound therewith in the event partial sets of plans and specifications are issued for bidding only. The submission of bids shall be deemed evidence of the review and examination of all drawings, specifications, and addenda issued for this project as no allowances will be made because of unfamiliarity with any portion of the complete set of documents.
- C. Connect new work to existing work in neat and approved manner. Restore existing work disturbed to original condition.
- D. Existing systems shall be left in perfect working order upon completion of all new work.
- E. Any equipment which is removed and not reinstalled shall be delivered on site to the Owner, or removed by the Contractor, as directed by the Owner.

1.2 SUB-CONTRACTOR QUALIFICATIONS:

- A. Sub-Contractor (as a company) and his job superintendent for their portion of the work shall have at least three years of satisfactory experience in completion of projects of comparable size and complexity. Evidence of this experience will be required before approval of the Architect as being acceptable for their portion of the work.

1.3 SCHEDULE:

- A. The schedule and sequence of work must be carefully coordinated through the General Contractor, with the Owner, to ensure that all work performed within the existing building will result in a minimal amount of noise, dust and disruption to the activities in the existing building.

- B. All interruptions of existing services must be coordinated through the General Contractor, with the Owner, to minimize inconvenience and disruption to the activities in the existing building. All interrupted services shall be restored as quickly as possible. All interrupted systems shall be thoroughly cleaned and tested prior to being placed back into operation.

1.4 SCOPE:

- A. The work included under this specification consists of the furnishing of all labor, materials, tools, transportation, services, etc., which are applicable and necessary to complete the installation of the systems described in these specifications, illustrated on the accompanying drawings, or as directed by the Architect.
- B. In general, the various lines and raceways to be installed by the various trades under this specification shall be run as indicated, as specified herein, as required by particular conditions at the site, as required to conform to the generally accepted standards and as required by all governing Building Codes so as to complete the work in a neat and satisfactorily workable manner. Run work parallel or perpendicular to the lines of the building unless otherwise noted.
- C. The construction details of the building are illustrated on the Architectural and Structural Drawings. Be thoroughly acquainted with the details before submitting a bid as no allowances will be made because of unfamiliarity with these details. Place all inserts to accommodate the ultimate installation of pipe hangers in the forms before concrete is poured. Set sleeves in place in forms before concrete is poured, and in masonry walls while they are under construction.
- D. The Electrical Contractor shall coordinate with the General Contractor, the requirements of all trades for temporary power during the construction phase. The Electrical Contractor shall provide the installation of temporary power distribution for those requirements as part of his work and at no additional cost to the owner.
- E. The Contractor shall coordinate the interruption of service to the existing building with the Owner and shall bear all costs and be fully responsible for scheduling his work to accommodate all Owner activities at this facility. He shall also provide temporary electrical service to the existing electrical systems as necessary so that the Owner may have the use of undisturbed portions of the existing building.

1.5 INSPECTION OF SITE:

- A. Visit the site, verify all existing items shown on plans, or specified, and be familiar with the working conditions, hazards, existing grades, actual formations, soil conditions, and local requirements involved; submission of bids shall be deemed evidence of such visit. All proposals shall take these existing conditions into consideration and the lack of specific information on the drawings shall not relieve the Contractor of any responsibility.

1.6 UTILITIES, LOCATIONS AND ELEVATIONS:

- A. Locations and elevations of the various utilities included within the scope of this work have been obtained from city and/or other substantially reliable sources and are offered separately from the Contract Documents, as a general guide only, without guarantee as to accuracy.

Examine the site, verify the locations, elevations, and availability of all utilities and services required, and be adequately informed as to their relation to the work; the submission of bids shall be deemed evidence thereof.

1.7 INSTRUCTIONS:

- A. When specified in other Sections, the contractor shall furnish the services of competent instructors who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the equipment or system specified. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation.
- B. The number of man-days of instruction to be furnished shall be as specified in the various Sections of the Specification.

1.8 CODE REQUIREMENTS:

- A. All work shall comply with the provisions of these specifications, as illustrated on the accompanying drawings, or as directed by the Architect, and shall satisfy the National Electrical Code and all applicable local codes, ordinances, or regulations of the governing bodies, and all authorities having jurisdiction over the work, or services thereto. In all cases where alterations to, or deviations from, the drawings and specifications are required by the authority having jurisdiction, report the same in writing to the Architect and secure his approval before proceeding. Upon completion of the work, furnish a statement from the inspecting authority stating that the installation has been accepted and approved. Provide complete utility service connections as directed, and submit, as required, all necessary drawings; secure all permits and inspections necessary in connection with the work, and pay all legal fees on account thereof. In the absence of other applicable local codes, acceptable to the Architect, the National Electric Code shall apply to this work.

1.9 MATERIALS AND WORKMANSHIP:

- A. All materials unless otherwise specified shall be new, free from any defects, and of the best quality of their respective kinds. All like materials used shall be of the same manufacture, model, and quality unless otherwise specified.
- B. All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, adjusted, and conditioned as recommended by the manufacturers, or as indicated in their published literature unless specifically herein specified to the contrary.
- C. All work shall be performed by competent workmen and executed in a neat and workmanlike manner providing a thorough and complete installation. Work shall be properly protected during construction, including the shielding of soft or fragile materials, and the temporary plugging of open conduits during construction. At completion, the installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of this portion of work shall be removed from the premises.

1.10 COOPERATION:

- A. All work under these specifications shall be accomplished in conjunction with other trades on this project in a manner which will allow each trade to complete his work in a timely fashion.
- B. Maintaining contact and being familiar with the progress of the general construction and timely installation shall be the responsibility of this trade to expedite this contract and avoid unnecessary delays in the progress of other trades.
- C. Should any question arise between the trades as to the placing of lines, ducts, conduits, fixtures, or equipment, or should it appear desirable to remove any general construction which would affect the appearance or strength of the structure, reference shall be made to the Architect for instructions.

1.11 DRAWINGS AND SPECIFICATIONS:

- A. The drawings show diagrammatically the locations of the various conduits, fixtures, and equipment, and the method of connecting and controlling them. It is not intended to show every connection in detail and all fittings required for a complete system. The systems shall include, but are not limited to, the items shown on the drawings. Exact locations of these items shall be determined by reference to the general plans and measurements at the building and in cooperation with other trades and, in all cases, shall be subject to the approval of the Architect. The Architect reserves the right to make reasonable change in the location of this work without additional cost to the Owner.
- B. Should any changes be deemed necessary in items shown on the contract drawings, the shop drawings, descriptions, and the reason for the proposed changes shall be submitted to the Architect for approval.
- C. Lay out all work maintaining all lines, grades, and dimensions according to these drawings with due consideration for other trades and verify all dimensions at the site prior to any fabrication or installation; should any conflict develop or installation be impractical, the Architect shall be notified before any installation or fabrication and the existing conditions shall be investigated and proper changes effected without any additional cost.
- D. Titles of Sections and Paragraphs in these specifications are introduced merely for convenience and are not to be construed as a correct or complete segregation or tabulation of the various units of material and/or work.

1.12 ARCHITECT'S APPROVAL:

- A. In the statement under this contract where "approval" is required or requested, it is understood that such approval must be obtained from the Architect in writing before proceeding with the proposal, and an adequate number of copies of any such proposal shall be submitted to the Architect.
- B. The approval of the Architect of any material, changes, drawings, etc., submitted will be considered as general only and to aid the Contractor in expediting his work. Such approval as

may be given does not in any way relieve the Contractor from the necessity of furnishing all materials and performing all work as required by the Drawings and Specifications.

1.13 LOCAL RESTRICTIONS:

- A. Contractor shall become familiar with rules and regulations of the City, County, and State; or any other authority having jurisdiction over this project; and if, in his opinion, any work or materials shown on the drawings or specified do not comply with these rules and regulations as to size, type, capacity, and quality, he should make it known to the Architect prior to the submission of his bid.

1.14 ELECTRIC WIRING:

- A. Except for such items as are normally wired up at the point of manufacture and so delivered, and unless specifically noted to the contrary herein, the Electrical Contractor shall do all electric wiring for power supply, including contactors, starters, etc. The other Contractors will erect all motors in place ready for connections. The Electrical Contractor shall mount all starters, as directed, furnishing supporting structures where necessary. The other Contractors will furnish with each item requiring electrical connections, the necessary instructions and wiring diagrams to this Sub-Contractor.

1.15 RESPONSIBILITY:

- A. This Contractor will be held responsible for the satisfactory and complete execution of all work specified or indicated. He shall produce complete finished operating systems and provide all incidental items required as part of this work, regardless of whether such item is particularly specified or indicated.

1.16 HANGERS AND INSERTS:

- A. All hangers, brackets, clamps, etc., shall be of standard weight steel. Perforated strap hangers shall not be used in any work. When two (2) or more conduits are run parallel, they may be supported on trapeze hangers. Other hangers shall be constructed with rods and hanger adjusters of adequate size to carry the loads imposed.
- B. Unless otherwise shown on the drawings, all horizontal runs of conduit and piping shall be suspended from the floor or roof construction, as the case may be, by means of approved hangers spaced not farther apart than ten feet (10') on centers, except that hangers for piping 1-1/4" in size and smaller shall not be spaced more the 8 feet on centers. Vertical risers shall be supported by approved riser clamps or supports installed at the respective floor lines.
- C. Supports and hangers shall be installed to permit free expansion and contraction in the raceway systems. Where necessary to control expansion and contraction, the raceways shall be guided and firmly anchored; anchors shall be approved by the Architect and shall be designed for equal effectiveness for both longitudinal and transverse thrust. No conduit shall be self-supporting, nor shall it be supported from equipment connections. Transmission of vibrations, noise, etc.,

shall be considered and any special suspension with vibration dampers to minimize transmission shall be used where necessary.

- D. Where ducts interfere with the proper location of hangers, furnish and install trapeze hangers. Trapeze hangers may be used to support groups of conduit run parallel.
- E. Above roof - Support conduit at no more than 8 feet on center, with manufactured pipe supports: Miro Industries Model 3-R to match existing supports on roof. The conduit supports shall be a roller-bearing type designed to support piping or conduit, and to absorb thermal expansion and contraction of piping or conduit thus preventing damage to roof membrane. The pipe or conduit shall rest on a polycarbonate resin roller and a glass- filled nylon rod situated in a polycarbonate resin seat.

1.17 GUARANTEE:

- A. The entire system shall be guaranteed to be complete and installed in accordance with these plans and specifications.
- B. Guarantee all new materials and workmanship for a period of one year from and after date of acceptance of installation. Replace, during the period of the guarantee, any parts found to be defective in their operation, without cost to the Owner.
- C. Incandescent lamps shall be excepted from requirements of this guarantee, but all electric discharge and quartz lamps shall be covered under the guarantee.

1.18 REFERENCE ABBREVIATIONS:

- A. References are made in the various electrical sections to technical societies, codes, specifications, trade organizations, and regulatory authorities in accordance with the following abbreviations:
 1. FM - Factory Mutual
 2. FS - Federal Specification
 3. IEEE - Institute of Electrical and Electronics Engineers.
 4. IPCEA - Insulated Power Cable Engineers Association
 5. IRI - Industrial Risk Insurors
 6. ISO - Insurance Services Organization
 7. NEC - National Electrical Code(NFPA Pamphlet No. 70)
 8. NEMA - National Electrical Manufacturer's Association
 9. NFC - National Fire Codes
 10. NFPA - National Fire Protection Association
 11. UL - Underwriters Laboratories, Inc.

1.19 SHOP DRAWINGS AND DATA TO BE SUBMITTED:

- A. SUBMITTALS WHICH DO NOT MEET THE FOLLOWING REQUIREMENTS WILL BE IMMEDIATELY REJECTED WITHOUT FURTHER REVIEW!

1. Catalog cutsheets and brochures will be preceded by a neatly arranged cover sheet having ample room for shopdrawing stamps and bearing the following information in a prominent, immediately visible location and size:
 - a. Equipment name or number as referenced in the contract Documents (example: "AHU-A" or "Type A" light fixture).
 - b. All options or accessories provided.
 - c. Applicable Specification section and paragraph numbers.

2. Substitutions -
 - a. Cross reference individual manufacturer and catalog numbers of substitute products to those of specified material.
 - b. Prior to requesting permission to use substitute or alternate products, the Contractor shall investigate and make certain that the product-
 - 1) Conforms with the standard of performance and quality specified.
 - 2) Will physically fit in the space allocated, with sufficient access and maintenance space.
 - 3) Involves no additional costs to the Owner or extended construction time.
 - c. Should the use of a substitute product entail any changes in details or construction, the changes and information documenting the complete coordination with all affected trades shall be submitted prior to submittal of substitute or alternate products
 - d. Provide with requests for permission to use substitute or alternate products, drawings, specifications, samples, performance data and other information as may be required to assist in determination of acceptability of the product. The burden of proof is the Contractor's responsibility.

3. All similar or related items shall be submitted together under one cover sheet (i.e. fixtures, raceways, wiring, equipment). Do not piece-meal submittals!!!

B. Submittal Items:

1. Submit manufacturer's certified data relative to equipment required for the installation of the electrical and electronic systems.
2. Submit adequate engineering data on each piece of equipment to allow a careful check of compliance with the technical requirements of the Contract Documents. Clearly indicate on submittal data the manufacturer's name, piece number, equipment capacity, and other applicable technical data.
3. Equipment, Electrical Systems Submittals:
 - a. New Power Distribution Equipment.
 - b. Wiring Devices and Cover Plates.
 - c. Lighting Fixtures.
 - d. Fire Alarm Systems.
 - e. Other Special Systems.

1.20 OPERATING AND MAINTENANCE MANUALS:

- A. Bind in looseleaf binders with the words, "Operating and Maintenance Manual" and the Project identification imprinted on the cover. Prepare three complete sets of records for the Owner, with table of contents, index, and tabbed Section dividers.
- B. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals-
 - 1. Copies or warranties and guarantees on each piece of equipment installed.
 - 2. Fixture brochures.
 - 3. Wiring and Control Diagrams.
 - 4. Approved Shop Drawings.
 - 5. Operating instructions.
 - 6. Recommended maintenance procedures.
 - 7. Lists of major items of equipment with name, address, and telephone number of each local representative.
- C. Submit the manuals for approval at approximately 75 percent job completion.

1.21 RECORD DRAWINGS:

- A. Accumulate Record Drawings during the construction of the Project. Keep one set of blue-line Contract Drawings at the job site at all times, and mark changes, rerouting or modifications which occur, clearly on the Drawings with dimensions.
- B. At completion of the job, deliver Record Drawings to Architect. Record Drawings shall be submitted for approval prior to final payment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer's names and catalog numbers are scheduled or specified for the purpose of establishing standard of design, quality, appearance, performance and serviceability, and not to limit competition. Scheduled products (as may be modified by detailed specifications) are those selected as the basis for system design with respect to physical size and space arrangements, required capacity and performance characteristics, and the product quality intended.
- B. The Drawings indicate specified products physically arranged in the spaces, as cataloged by specific manufacturers, generally as listed in the Equipment Schedules.
- C. Listed "Acceptable Manufacturer's" are those considered capable of manufacturing products conforming to detailed Specifications, and as such, are invited to compete on an equal basis provided the offering is comparable in every respect to scheduled or specified products and actually conforms to the detailed Specifications and Schedule requirements. Listing herein as "acceptable manufacturers" does not imply "accepted", "approved", or "prior approval", or any other such connotation.

- D. Vendors are invited to submit material or equipment bids to bidding Contractors on any comparable equivalent product, whether or not the manufacturer of such product is listed herein as an "acceptable manufacturer". Such product bids should clearly indicate offerings that are not listed as "acceptable manufacturer's". In the event a bidding Contractor, after satisfying himself that such unlisted product is in fact "equal" to the specified product with respect to design, quality, performance and arrangement (space requirements), and the Contractor desires to furnish that product on the Project, he may request the name of the manufacturer be added to the list of acceptable manufacturers by addendum prior to bid time.
- E. At a bidder's request, an unnamed manufacturer's equipment will be considered to determine additional "acceptable manufacturers" if a request is made in writing no later than ten days prior to the bid opening. If such requests are found acceptable, an addendum will be written listing additional acceptable manufacturers. Consideration will be given only to requests of bona fide bidders (Contractors), not to those received from vendors.
- F. Manufacturers of materials and equipment shall be as specified, scheduled, or as listed in each respective product Specification Article.

2.2 FLAME SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS:

- A. Materials and adhesives used throughout the electrical systems shall have a flame spread rating not over 25 without evidence of continued combustion and with a smoke developed rating not higher than 50. If such materials are to be applied with adhesives, they shall be tested as applied with such adhesives, or the adhesives used shall have a flame spread rating not over 25 and a smoke developed rating not higher than 50. (Note: materials need not meet these requirements where they are entirely located outside of a building and do not penetrate a wall or roof, and do not create an exposure hazard or where specifically exempted in the body of these Specifications).
- B. "Flame Spread Rating" and "Smoke Developed Rating" shall be as determined by the "Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 255, ASTM E84, Underwriters Laboratories, Inc., Standard". Such materials are listed in the Underwriters Laboratories, Inc. "Building Materials List" under the heading "Hazard Classification (Fire)".

2.3 SLEEVES AND ESCUTCHEONS:

- A. Generally, where conduits pass through walls or floors, 22 gauge galvanized sheet iron sleeves shall be used, except those in beams, outside walls, or structural walls or members which shall be standard galvanized steel pipe. The size of these sleeves shall be such as to permit readily the subsequent insertion of conduit of the proper size with adequate clearance for movement due to expansion and contraction. Where conduits pass through outside walls, the inside diameter of the galvanized iron pipe sleeves shall be at least 1/2" greater than the outside diameter of the service pipe. After the conduits are installed, fill the annular space between the conduit and its sleeve with a mastic or caulk with lead. Use packing as required to accomplish this.
- B. Sleeves in existing masonry load bearing walls shall be schedule 40 steel pipe grouted in place with structural grout. For exterior walls, the space between the pipe and the sleeves shall be packed with oakum or jute twine and calked watertight.

- C. Escutcheons, except as specifically noted or specified, shall be installed on all conduits passing exposed through the floors, walls, or ceilings. Escutcheons shall be equal to the Crane No. 10 chrome plated sectional floor and ceiling plates and shall fit snugly and neatly around conduit. Solid chrome plates with set screws shall be used if sectional plates do not fit properly or stay in place.

2.4 FIRE STOPPING:

- A. Seal annular spaces between sleeves and penetrating materials in fire rated floors, ceilings, and walls with fireproof and waterproof silicone elastomer applied in accordance with the manufacturer's published instructions. Multiple penetrations shall be sealed with silicone caulking. Seal material shall be UL classified for use in fire rated penetration seals, and shall be applied in the manufacturer's recommended thickness for the fire rating of the penetrated structure in accordance with ASTM-E-814 requirements.
- B. Acceptable Manufacturers - Dow Corning, General Electric, Hilti.

2.5 WATERPROOFING:

- A. Seal penetrations of wet or potentially wet structures, floors, exterior walls, etc., other than those requiring fire stopping, with sealant to prevent moisture leakage. Apply sealing material (caulking) in accordance with manufacturer's published instructions.
- B. Product Research and Chemical Co. "Poly-Sulphide Sealant" PRC- 5000.

2.6 CABINETS:

- A. Provide cabinets where indicated and where necessary.
- B. Provide flush type in finished areas centered in paneling and other Architectural features.
- C. Provide surface type in equipment rooms, above accessible finished ceilings, and in crawl spaces.
- D. Install lighting and power cabinets with tops 6 feet 6 inches above finished floor.
- E. Cabinets for Panelboards shall be of same manufacturer as panelboard interiors. Cabinets for timeclocks, contactors and other electrical equipment supplied under this division may be of other manufactures complying with NEMA, UL and nec requirements. All boxes shall be code gauge steel, welded with edges turned to receive trim, and galvanized. Trim and doors shall be No. 12 gauge steel minimum, hinged door, flush tumbler lock and catch keyed alike throughout the work, factory enamel finish, suitable for field color coat. For flush panels provide covers with overlap minimum 3/4 inches top, bottom, and sides. For surface mounted panels covers shall be same size as cabinet.
- F. Identify all cabinets for all panelboards, switchboards, disconnect switches, transformers, motor starters, and electrical equipment furnished shall be provided with engraved phenolic lamacoid

plastic name plates with 1/2 inch block engraving. Name plates shall give equipment designation as scheduled on the drawings and voltage and phase of service.

2.7 GROUNDING:

- A. Provide grounding of electrical system in accordance with the National Electrical Code NFPA 70, UL 467, and IEEE 837 for grounding and bonding materials and equipment.
1. Equipment grounding conductors shall be sized in accordance with the National Electrical Code Equipment Grounding Conductor Table on the basis of the circuit overcurrent protection device rating.
 2. Bond together the following items to serve as a single grounding electrode for all electric services:
 - a. Minimum 20 feet BHD copper conductor encased in concrete footing or grade beam in contact with earth.
 - b. Structural steel building framework.
 - c. 10'-0" X 3/4" diameter copper-clad steel ground rod(s).
 - 1) Where more than one ground rod is required to meet specified resistance, ground rods shall be located at least 10 feet apart. Interconnect with grounding electrode conductor below grade unless otherwise indicated.
 - d. Metal underground water pipe.
 3. The grounding electrode shall be connected by a grounding electrode conductor sized in accordance with the National Electric Code Table 250-94 to the service neutral bus.
 4. Provide a main bonding jumper from the grounded service neutral bus to the main equipment ground bus or point of termination of the equipment grounding conductors.
 5. Provide bonding jumpers for attachment of each metallic water, fuel, fire suppression, steam, gas or air piping system to the building grounding electrode system. Provide connections with listed connectors applied to the piping in an approved method. The points of attachment of the bonding jumpers shall be accessible. The bonding jumper size shall match the main grounding electrode conductor.
 6. Grounding system resistance must not exceed 5 ohms. Final tests shall be conducted to ensure that this requirement is met.
- B. Provide equipment grounding conductors for all circuits. A green insulated, copper ground conductor shall be installed with all circuits so as to make an electrically continuous ground system.
- C. Ground all non-current carrying equipment, such as cable tray and equipment structures.
- D. Grounding Connectors:
1. Listed and labeled by a NRTL acceptable to the authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
 2. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
 3. Welded Connections:

- a. Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
 - b. For structural steel, steel grounding stud for compression connector.
4. Compression Connectors: Hydraulic crimped, irreversible compression type kits. Connectors shall be factory filled with oxide inhibitor. All crimps shall be made with a hydraulic tool that embosses the index number on the outside of the connector. Compression type connections shall be allowed above and below grade where any permanent connection is required.
 5. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

E. Field Quality Control

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation. Inspect compression type connections for proper die index number embossment.
2. Perform the following testing:
 - a. After installing grounding system, but before permanent electrical circuits have been energized, test for compliance with requirements.
 - b. Test completed grounding system as each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at ground rods. Make tests at ground rods before any conductors are connected.
 - c. Measure ground resistance no fewer than two full days after the last trace of participation 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.
 - d. Perform tests for fall-of-potential method according to IEEE 81. Submit test results to the Engineer.
 - e. If resistance to ground exceeds specified values, promptly notify Engineer and include recommendations for reducing ground resistance.

2.8 IDENTIFICATION:

- A. Provide engraved phenolic lamacoid plastic name plates with 1/2 inch block engraving. Name plates shall give equipment designation as scheduled on the drawings.
- B. After balancing branch circuits, provide each breaker panel with a typed directory which identifies specifically the branch circuit loads and location. Use architectural room names and designations found on the Contract Documents.
- C. Provide labels for fused switches indicating equipment served and unit capacity in horse power or full load amperes and the installed fuse rating.

2.9 WIRE AND CABLE:

- A. Provide systems of wires and cables for electric power, signalling, and control.

B. Materials:

1. Conductors shall be soft drawn annealed, conductivity of 98% pure copper. No. 10 AWG and Smaller: Solid copper. No. 8 AWG and Larger: Stranded copper.
2. Other: Pull Cords - 1/8" nylon. Pulling Compound - Ideal "Yellow 77".

C. Install Wire Types:

1. THHN/THWN, XHHW for light and power branch circuits and control wiring.
2. THHN/THWN, XHHW for feeders, sub-feeders, motor circuits and high ambient temperature locations.

D. Consistently color code wiring continuous throughout the work with insulation factory color-coded by pigmentation.

1. 120/208 Volt Systems:

- a. Phase A - Black
- b. Phase B - Red
- c. Phase C - Blue
- d. Neutral - White
- e. Ground - Green

2. 277/480 Volt Systems:

- a. Phase A - Brown
- b. Phase B - Orange
- c. Phase C - Yellow
- d. Neutral - Gray
- e. Ground - Green

3. Switch legs, travelers, and special systems continuous throughout the work as selected by the Contractor.
4. Where factory colors are not available, code ends of conductors with 1-1/2 inch colored tape.

E. Circuits of multiple phases passing through enclosures shall have phases grouped to reduce the reactance effect.

F. Minimum Sizes:

1. Light and Power Branch Circuits, 15 and 20 amperes OCP:

- a. Minimum branch circuit: No. 12 AWG
- b. 120V longer than 80 feet first outlet to panel: No. 10 AWG.
- c. 120V longer than 120 feet from first outlet to panel: No. 8 AWG
- d. 277V longer than 130 feet from first outlet to panel: No. 10 AWG.
- e. 277V longer than 220 feet from first outlet to panel: No. 8 AWG.

2. All branch circuits shall have dedicated full ampacity neutrals, or shared neutral conductors serving two or three branch circuits shall be sized at 175% of the maximum

branch circuit overcurrent device, based on the 75°C ratings in Table 310-16 of the National Electrical Code. Shared neutral conductors shall be considered as current-carrying conductors for the purpose of derating conductor ampacities for installation of more than three current-carrying conductors in a raceway or cable.

3. Other circuits sized to limit voltage drop per National Electrical Code.
4. Control Wiring: No. 14 AWG, unless otherwise specified.

- G. Acceptable Manufacturers - American Insulated Wire Corp., Cablec Corp., Cerrowire, Essex, Guardian, Rome Cable, Triangle.

2.10 OUTLET BOXES:

- A. Provide outlet boxes for the installation of wiring devices, lighting fixtures, fire alarm devices and power and control connections. Provide boxes at the terminal of conduit runs to outlets and devices and for installation of conductors as required by the NEC.
- B. Locate switch boxes at locations designated by Architectural Documents when indicated. If Architectural locations are not identified use appropriate locations consistent with schematic indications on Electrical Documents. Where application of switches repeats installation type and relative locations shall be consistent throughout project unless indicated otherwise.
- C. Provide standard manufactured plugs in unused openings of boxes. Provide plaster rings and covers where required by the building structure. Rigidly attach boxes to structure and ceiling supporting members in suspended ceilings to avoid cutting mechanical ceiling members.
- D. Materials: Metallic boxes shall be of welded or one piece cast construction.
1. Flush Mounted Outlet Boxes: Standard, stamped galvanized steel with factory conduit knockouts, one piece and welded construction.
 2. In dry walls for single and two gang outlet provide 4S and 4D boxes, for 3 or more outlets use masonry boxes.
 3. In block and masonry walls provide masonry boxes of depths required for wall thickness.
 4. In ceilings provide 4 inch boxes. Omit covers if standard canopy and device plates entirely cover the ceiling opening.
 5. In exposed work, exterior of the building, in wet locations, and flush in non-waterproofed walls below grade provide FS and FD boxes.
 6. Unless instructed otherwise on drawings, for telephone and data outlets, provide empty flush mounted wall box with 3/4-inch conduit in wall to accessible ceiling space.
 7. See scheduled flush floor boxes on drawings.
- E. Location: Install center of box at heights above finished floor unless other directions are indicated in Contract Documents:
1. Wall Switches: 47 Inches
 2. Convenience Outlets: 18 Inches
 3. Telephone/Data Outlets: 18 Inches
 4. Boxes Indicated Above Counters (CT): 6 Inches above backsplash and trim, unless otherwise indicated.
- F. Do not use through-the-wall and back-to-back boxes.

2.11 WIRING DEVICES:

- A. Samples: Provide two samples of each type and color of wiring device and respective cover plate utilized in the project. Provide other samples upon specific request for typical NEMA devices. Colors of all exposed devices shall be as herein specified, and shall be submitted for final approval by Architect.
- B. Cover Plate and Wiring Device colors:
 - 1. Finished areas: Grey devices with stainless steel cover plates.
 - 2. Maintenance and equipment rooms: Grey devices and galvanized steel coverplates.
- C. Cover Plates for Telephone and Data Boxes: Blank, brushed stainless steel, unless otherwise noted on plans.
- D. Weatherproof Cover Plates: Corrosion resistant finish metal plate, die cast cover, and gasket.
- E. Cover Plates for Surface Mounted Outlet Boxes: Zinc coated sheet steel rounded edges, same size as outlet box.
- F. Wiring Device Schedule (Based on Leviton Specification Grade) -
 - 1. Standard duplex receptacle - 125V, 20A, NEMA 5-20: #5352.
 - 2. Special receptacles - type and NEMA configuration as indicated on drawings.
 - 3. Ground fault circuit interrupting duplex receptacle - 125V, 20A, NEMA 5-20: #6898.
 - 4. One pole wall toggle switch - 120/277V, 20A: #1221-2.
 - 5. Two pole wall toggle switch - 120/277V, 20A: #1222-2.
 - 6. Three-way wall toggle switch - 120/277V, 20A: #1223-2.
 - 7. Four-way wall toggle switch - 120/277V, 20A: #1224-2.
 - 8. Special switches - As indicated on plans.
 - 9. Acceptable Manufacturers - Eagle, Hubbell, Leviton, Pass and Seymour.

2.12 CONDUITS:

- A. Provide a mechanically and electrically complete conduit system.
- B. Rigid Metal Electrical Conduit: Hot-dipped galvanized steel with zinc coated threads and an outer coating of zinc bichromate, complete with one coupling and one end thread protector.
- C. Intermediate Metal Conduit: Hot-dipped galvanized steel, complete with one coupling and one end thread protector.
- D. Electrical Metallic Tubing: Welded, electro-galvanized thin wall steel tubing.
- E. Flexible Metal Electrical Conduit: Hot-dipped galvanized steel strip core with integral copper ground wire on sizes 1-1/4" and smaller.
- F. Liquidtight Flexible Metal Electrical Conduit: Hot-dipped galvanized steel strip core with extruded polyvinyl jacket, O-Z Gedney Type UAG.

- G. Rigid Nonmetallic Electrical Conduit: Schedule 40 heavy wall polyvinylchloride, high impact resistant.
- H. Elbows and Bends:
1. For rigid nonmetallic conduit systems, use rigid metal electrical conduits.
 2. For other conduit systems, use same material as the conduit with which they are installed.
 3. For all types, size 1-1/4 inch and larger shall be factory manufactured.
- I. Bushings:
1. 1-1/4" and Smaller: Same material as the conduit with which they are installed.
 2. 1-1/2" and Larger: Hot-dipped galvanized with thermosetting phenolic insulation, 150 Deg.C., O-Z/Gedney Type "B".
- J. Locknuts:
1. 1-1/2" and Smaller: Zinc plated heavy stock steel, O- Z/Gedney.
 2. 2" and Larger: Cadmium plated malleable iron, O-Z/Gedney.
- K. Hubs: Cadmium plated malleable iron, tapered threads, neoprene "O" ring, insulated throat, O-Z/Gedney.
- L. E.M.T. Fittings:
1. Compression Connectors and Couplings: Gland compression type, die cast zinc body, malleable iron nut, insulated throat, O-Z/Gedney, Raco, Red Dot.
 2. Set Screw Connectors and Couplings: Die cast zinc body, single set screw for 1/2" - 1" sizes, two set screws for 1 1/4" - 4" sizes, O-Z/Gedney, Raco, Red Dot.
- M. Liquidtight Conduit Connectors: Cadmium plated malleable iron body and nut, cadmium plated steel ferrule, insulated throat, integrally cast external ground lug, O-Z/Gedney Type 4QL.
- N. Seals for Wall and Floor Penetrations: Malleable iron body, oversize sleeve, sealing ring, pressure clamp and rings and sealing grommet, hex head cap screws, O-Z/Gedney Type FSK.
- O. Fire Seals: Heat activated intumescent material, elastomeric sealing ring, socket head cap screws, steel pressure discs and flange, O-Z/Gedney Type CFSF.
- P. Expansion Fittings: Hot-dipped galvanized malleable iron with bonding jumpers.
- Q. Escutcheons: Chrome plated sectional floor and ceiling plates, Crane No. 10.
- R. Accessories: Reducers, bushings, washers, etc., shall be cadmium plated malleable iron on the forms and dimensions best suited for the application.
- S. Size conduits as indicated on the drawings and as required by the NEC for the number and sizes of wires to be drawn into conduit. Do not use conduit sized less than 3/4" unless specified otherwise.

- T. Conceal conduits from view in all areas except mechanical and electrical equipment rooms, attics and crawl spaces.
1. Should it appear necessary to expose any conduit, bring specific information to the attention of the Architect immediately, and rearrange the work to facilitate an approved installation.
 2. Where conduits must be exposed in finished areas, utilize paintable surface mounted vinyl or metal raceways, fittings and boxes equivalent to Wiremold or Hubbell. No exposed circuitry shall be installed in finished spaces without prior approval of Architect.
- U. Installation:
1. Install all conduits at elevations and locations to avoid interference with grading of other work, the structure, finished ceilings, walls. Avoid causing cutting of masonry units.
 2. Install conduits before concrete is placed, and in advance of masonry work. Run conduits imbedded in structural slabs in the middle of the slab below the top and above the bottom reinforcing steel. Maintain a minimum 1-1/2" cover except where penetration is made. Do not install conduit larger than 1" in slabs.
 3. Install conduits through roof in time to be flashed prior to roofing application.
 4. Cap or plug conduits with standard manufactured accessories as soon as the conduits have been permanently installed in place.
 5. Where space conditions prohibit the use of standard ells, elbows, and conduits, use cast ferrous alloy fittings of such forms and dimensions as best required for the application.
 6. Make all conduit joints mechanically tight, electrically continuous, and watertight. Pitch conduits in a manner to avoid creating moisture traps.
 7. Connect and couple E.M.T. with compression or set screw type fittings. Do not use indentor fittings.
 8. Install and neatly rack exposed conduits parallel with and perpendicular to the building walls. Do not install exposed diagonal conduit runs.
 9. Do not run conduits exposed on the roof unless approval is obtained prior to installation.
 10. Do not place conduits in close proximity to equipment, systems, and service lines, such as hot water supply and return lines, which could be detrimental to the conduit and its contents. Maintain a minimum 3" separation, except in crossing, which shall be a minimum 1".
 11. Connect motors, equipment containing motors, equipment mounted on an isolated foundation, transformers, and other equipment and devices which are subject to vibration and which require adjustment with flexible metallic conduit from the device to the conduit serving it. Size the flexible conduit length more than 12 diameters, but less than 18 diameters. Rigidly support the points of attachment on each side of the connection. Use external bonding jumpers on sizes 1-1/2" and above.
 12. Install escutcheons on all exposed conduits passing through interior floors, walls, or ceilings. Install fire seals on all conduits passing through fire rated partitions. Install wall and floor fire seals on all conduits passing through exterior walls and floors, or use standard galvanized steel pipe sleeves; diameters 1/2" greater than the outside diameter of the sleeved conduit and fill the annular space with mastic.
 13. Install rigid metal electrical conduit for feeders and sub-feeders, and for all used in damp and wet locations and in hazardous areas.
 14. Install electrical metallic tubing for branch circuits concealed in walls and above ceiling for size 2" and smaller.

15. Install rigid non-metallic conduit with manufactured spacers for feeders and branch circuits run underground exterior to the building, or underground and beneath the building, or where specifically noted. Use rigid metal conduit long radius sweeps for offsets and changes in direction. Use rigid metal conduit for risers and where exposed above slab or grade.
16. Install flexible metal conduit where specified above and where permitted by the authorities having jurisdiction for final connections to lighting fixtures which have isolated junction boxes. Use liquid-tight flexible conduit for exterior applications, in damp and wet locations.
17. Install pull cords in all empty raceway systems, tagged with the identification of service intended and location of opposite end.

2.13 ACCESS DOORS:

- A. Furnish, for installation under appropriate Section of the Work, access doors at each point required to provide access to concealed valves, dampers, damper operators, and other devices requiring operation, adjustment, or maintenance.
- B. Shall be 16 gage steel, with mounting straps, concealed hangers, and screwdriver locks, designed for the doors to open 180 degrees, minimum.
- C. Access doors installed in fire walls or partitions shall be UL labeled to maintain surfaces.
- D. Provide prime coat finish for installation in ceilings or painted or unfinished surfaces.
- E. Provide polish chrome plate finish for installation in unpainted finished walls.
- F. Acceptable Manufacturers - Baldwin, Hannon, Josam, Miami, Carey, Milcor, Titus, Wade, Walsh, Zurn.

PART 3 - EXECUTION

3.1 PROTECTION OF EQUIPMENT:

- A. Protect equipment from physical damage and deterioration after it is delivered to the Project, and during the installation period prior to Owner acceptance. Repair scratches, mars, or paint deterioration.

3.2 EQUIPMENT SPACE:

- A. The Drawings indicate specified products physically arranged in the spaces, as cataloged by specific manufacturers, generally as listed in the Equipment Schedule.
- B. Coordinate the exact physical space requirements for equipment and servicing of equipment actually purchased for each item of equipment involved.
- C. Keep horizontal lines as close to ceiling as practicable.

- D. Adhere to Drawings as closely as possible in layout of work.
- E. Vary run of conduits and make offset during progress of work as required to meet structural and other interferences.
- F. Install conduits in furred spaces wherever possible. Run exposed conduits parallel to or at right angles to buildings walls.
- G. Conform to ceiling heights established on architectural construction drawings.

3.3 INTERFERENCES:

- A. Relocate or reroute existing conduit, wiring, or equipment as required to facilitate construction of finished work as planned. Restore surfaces, insulation, and finish to match condition of adjacent work.

3.4 CUTTING AND PATCHING:

- A. Assume costs and responsibility for cutting and patching required to complete the installation. Patching shall be finished to match adjacent surfaces to the satisfaction of the Architect.

3.5 PAINTING AND FINISHING AND CLEANING:

- A. Provide touchup painting of prefinished electrical products.
- B. Surfaces shall be left clean and debris shall be removed.
- C. Clean all light fixture lenses, lamps and reflectors.

3.6 OPTION TO RELOCATE OUTLETS AND RELATED DEVICES:

- A. Electrical outlets and light fixtures may be relocated at the Owner's option to points within 10-feet of their indicated locations, at no additional cost to the Owner, provided the Contractor is notified prior to roughing-in and fabrication.
- B. Only work which must be reperformed in this connection will be considered extra.

3.7 TESTS AND LOAD BALANCING:

- A. Test all circuits to assure them to be free of grounds. Prove and test energy available at the load side of disconnect switches and the final point of connection to driven equipment. Make all reasonable tests as required by the Architect to provide the integrity of the work and leave the complete electrical installation in first class condition and ready for operation.

- B. Balance the load on each phase when connecting the various branch circuits in each panel board. When all load is turned on and the system is in operation at 100% demand, the initial unbalance shall not exceed 10%.
- C. Furnish at the completion of the job, a final inspection certificate from the local inspecting authority.

3.8 ELECTRICAL DISCONNECTS:

- A. Provide disconnects where indicated and where required by the National Electrical Code. Install within sight of electrified equipment served and provide final connection to equipment served.
- B. Provide switch sizes as required by the National Electrical Code based on the equipment actually furnished under other Divisions or provided by the Owner.
- C. Provide NEMA 1 enclosure indoors, NEMA 3R enclosure exterior, in damp or wet locations and in crawl spaces, flush and surface as specified for outlet boxes.

3.9 EQUIPMENT CONNECTIONS:

- A. Provide wiring for the connection of motors and control equipment and control wiring as indicated on the Electrical Drawings.
 - 1. Equipment installed under Other Sections - wiring shall be extended to the equipment, and proper connections made thereto.
 - 2. Flexible connections of short lengths - shall be provided for equipment subject to vibration or movement and for motorized and compressor equipment. Liquid-tight conduit shall be used in wet locations. A separate ground conductor shall be provided across flexible connections.

3.10 EXCAVATION AND BACKFILLING:

- A. Provide necessary excavating and backfilling for the installation of work specified in this Division. Trenches for underground conduits shall be excavated to required depths as necessary to insure uniform bearing. Care should be taken not to excavate below depth, and any excavation below depth shall be refilled with sand or gravel firmly compacted. Where rock or hard objects are encountered, they shall be excavated to a grade six inches (6") below the lowermost part of the raceway and refilled to the raceway grade as specified. After the raceway has been installed, tested, and approved, the trenches shall be backfilled to grade with approved material, in 12 inch layers wetted and compacted to density of adjacent soil. Complete backfill to grade to result in a well compacted trench to 95% compaction by the standard Proctor test. Where streets, sidewalks, etc., are disturbed, cut, or damaged by this work, the expense of repairing same in a manner approved by the Architect shall be a part of this work.

END OF SECTION 26 01 00

SECTION 26 16 00 - POWER DISTRIBUTION EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Provide distribution panelboards, branch circuit panelboards, motor control centers, transformers and power factor correction equipment, as scheduled and specified for the electrical distribution system.

1.2 QUALITY ASSURANCE:

- A. Source Quality Control: Tests to meet applicable standards of the following:
 - 1. Underwriters' Laboratories.
 - 2. National Electrical Manufacturer's Association.
 - 3. National Electrical Code.
 - 4. American National Standards Institute.

1.3 SUBMITTALS:

- A. Submit shop drawings in accordance with other Sections. Include layouts showing cabinet dimensions, conduit entrances, electrical ratings, bussing connections, single line diagrams, device locations and ratings, and cable termination provisions.
- B. Certificates:
 - 1. Labels of Underwriters' Laboratories affixed to each item of material.
 - 2. Label of Underwriters' Laboratories approval for service entrance use, where applicable, affixed to material.
- C. See section 26 01 00.

PART 2 - PRODUCTS

2.1 POWER DISTRIBUTION EQUIPMENT:

- A. Branch Circuit Panelboards:
 - 1. Equivalent to Square D Type NQ and NF, all bussing - copper.
 - 2. Single phase, 3 wire, and 3 phase, 4 wire, solid neutral design with sequence bussing and full capacity neutral.
 - 3. Provide scheduled circuit breakers, minimum 10,000 A.I.C. for 208 volt and 14,000 for 480 volt.

4. Provide feed thru lugs where extension of primary feeders is required.
5. Provide cabinets of NEMA type appropriate for application.
6. Provide isolated ground bus where scheduled.

B. Circuit Breakers:

1. Resettable, quick-make, quick-break, thermal magnetic type, ambient compensated, trip free with separate trip position from on and off positions.
2. Multiple pole breakers with common trip and one operating handle. Do not provide handle ties.
3. 15 and 20 ampere, single pole circuit breakers shall be U.L. listed as switching duty rated.
4. Wire with sequence phasing.
5. Provide circuit breakers of appropriate capacity for all unscheduled circuits.
6. For panelboards rated 600 amperes or greater, provide bolt- on type circuit breakers.
7. Provide U.L listed HACR circuit breakers for compressorized equipment loads where the circuit breaker serves as the final overcurrent protection.
8. Where indicated on the panel schedule, provide panel mounted power supply to provide 24 volts DC switching power for remote controlled circuit breakers.
9. Breakers indicated to be "Remote Controlled":
 - a. Circuit breakers shall be UL Listed and rated 120/ 240Vac (1- and 2-pole) and 240Vac (3-pole) with continuous current ratings as shown on the plans.
 - b. Circuit breakers shall have an overcenter, trip-free, toggle type, quick-make/quick-break mechanical action and positive handle indication. Handle shall have on, off, and tripped positions. In addition, trip indication shall include a trip indicator on the face of the breaker case.
 - c. Multi-pole breakers shall have internal crossbars for common trip operation.
 - d. Circuit breaker contacts shall be open when breaker is in the OFF or "tripped" position regardless of remote signal.
 - e. Interrupting capacity shall be 10,000 rms symmetrical amperes.
 - f. 15A and 20A breakers shall be SWD rated.
 - g. Multipole circuit breakers rated 15-60A shall be UL Listed for HACR applications.
 - h. All circuit breakers shall have contacts suitable for use on HID lighting systems.
 - i. Circuit breakers shall be marked "Remote Controlled" in such a way that the marking is visible with the trim installed.
 - j. Circuit breakers shall have terminals suitable for use with Al/Cu 75°C wire.
 - k. Circuit breakers shall be capable of operating for 30,000 operations at rated voltage and current with an 80% lagging power factor.
 - l. Remote-control shall be accomplished via a 24Vdc high speed motor with clearing switch that clears the motor circuit upon circuit breaker contact opening or closing.
 - m. Motor shall operate no more than 50 milliseconds at rated voltage (24Vdc) $\pm 10\%$ and draw no more than 2A instantaneous. Maintaining the control signal shall have no adverse effect on the breaker.

C. Acceptable Manufacturers – Eaton, General Electric, Siemens, Square D.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. Carefully measure and lay out exact locations of equipment in conference with the Construction Manager.
- B. Assure that equipment may be installed without adversely affecting the integrity and appearance of the building structure and with the clearances required by the National Electrical Code.

3.2 INSTALLATION:

- A. Provide panelboards of the types and ratings scheduled where indicated.
- B. Provide flush and surface mounted types where indicated and scheduled.
 - 1. Provide multi-section cabinets as required and scheduled; one-piece covers and doors, main and sub-feed lugs as required.
 - 2. Provide hinged doors with flush tumbler lock and catch, all locks keyed alike.
 - 3. Provide 3 keys for each panelboard.
- C. Provide supports to the building structure, independent of raceways.
- D. Install tops of panelboard cabinets at 6 feet, 6 inches, above finished floor.
- E. Install panelboards in cabinets, centered in door openings.
- F. Provide Identification:
 - 1. For Panelboards - Engraved, lamacoid plastic name plate, giving equipment designation.
 - 2. For Distribution and Branch Circuit Panelboards: - Neatly typewritten circuit directory in cardholder inside panelboard door.
 - a. For Branch Circuit Panelboards: Identify rooms served using room numbers corresponding to those finally established at the project.
 - b. For Distribution Panelboards: Identify the equipment served and give circuit designation.
 - c. For motor starters identify equipment designation as scheduled on the drawings, voltage and phase of service, and the source of power.
- G. Provide Vibration Isolation for Suspended Transformers:
 - 1. Provide spring hangers, equivalent to Mason Type PC30, 1" deflection, consisting of a rectangular steel box, coil spring, spring cups, neoprene impregnated fabric washer, and steel washer, with an elastomeric element at the top of the box for acoustic isolation. The design shall be such as to prevent metal-to-metal contact between the hanger rod and the top of the hanger box. The elastomeric element shall be designed for approximately 1/4-inch deflection and loaded so that deflection does not exceed 15 percent of the free height of the element.
 - 2. Install the isolators with the isolator hanger box as close as possible to the structure.
 - 3. Suspend the isolators from the building structure, never from slab diaphragms between beams.

3.3 FIELD QUALITY CONTROL:

- A. Perform manufacturer's recommended field tests prior to energization.
- B. Provide copies of test results to the Owner's representative.

END OF SECTION 26 16 00

SECTION 26 17 00 - MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide disconnect switches for branch circuit, motor circuits, and all items of equipment in conformance with the National Electric Code.

1.2 QUALITY ASSURANCE

- A. Source Quality Control: Tests to meet applicable Underwriters' Laboratories, Inc. Standards, the National Electrical Manufacturer's Association and the National Electrical Code.

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with other Sections. Include enclosure dimensions, type, electrical ratings, fuse provision, installation instructions, and name plate nomenclature.
- B. Certificates:
 - 1. Labels of Underwriters' Laboratories, Inc. affixed to each item of materials.
- C. See Section 26 01 00.

1.4 JOB CONDITIONS:

- A. Provide switch sizes as required by the National Electrical Code based on the equipment actually furnished under other Divisions or provided by the Owner.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. For single phase motors under 1/2 horsepower: Equivalent to Square D Class 2510 Fractional Horsepower single phase two pole manual starter with toggle type switch, locking attachment, neon pilot light, thermal overload elements sized per motor name plate rating and NEMA 1 enclosure indoors, NEMA 4 enclosure exterior, in damp or wet locations and in crawl spaces, flush and surface as specified for outlet boxes.

- B. For single and three phase motors, 120, 230, 480 volts, 1/2 to 3 horsepower, requiring manual starters: Equivalent to Square D Class 2510 Integral Horsepower manual starter with toggle type switch, low voltage protection, pilot light, thermal overload elements sized per motor name plate rating with number of poles required for specific application and NEMA 1 enclosure indoors, NEMA 3R enclosure exterior, in damp or wet locations and in crawl spaces, flush and surface as specified for outlet boxes.
- C. For Other 250 Volt Equipment: Equivalent to Square D Class 3130 NEMA Type GD Safety Switches, fusible and non-fusible as required by NEC with cover interlocks, with NEMA cabinet required for application, with threaded hubs.
- D. Acceptable Manufacturers - Cutler Hammer, General Electric, Siemens ITE, Square D.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect building structure to which disconnects are to be secured for defects which affect the execution and quality of work.
- B. Do not start work until defects are corrected.

3.2 PREPARATION

- A. Carefully measure and lay out exact locations maintaining working clearances required by the National Electrical Code.

3.3 INSTALLATION

- A. Provide disconnects where indicated and where required by the National Electrical Code.
- B. Install within sight of equipment served.
- C. Provide final connection to equipment served.
- D. Provide name plate secured to cabinet with designation of equipment served, operating voltage, and circuit designation.

3.4 EQUIPMENT CONNECTIONS

- A. Provide wiring for the connection of motors and control equipment and control wiring as indicated on the Electrical Drawings.

1. Equipment installed under Other Sections - wiring shall be extended to the equipment, and proper connections made thereto.
2. Flexible connections of short lengths - shall be provided for equipment subject to vibration or movement and for motorized and compressor equipment. Liquid-tight conduit shall be used in wet locations. A separate ground conductor shall be provided across flexible connections.
 - a. Length of flexible connections for motors shall be at least 11-inches plus 1/4-inch per horsepower up to 100 hp, and need not be longer than 36-inches unless otherwise indicated.
 - b. Length of flexible connections for transformers shall be at least 11-inches plus 1/4-inch per KVA up to 100 KVA, and need not be longer than 36-inches unless otherwise indicated.
3. Power connections to any vibration isolated equipment shall be made with a length of flexible conduit having a 90 degree bend in it between the junction box on the equipment and any non-flexible conduit.
4. Owner furnished equipment - wiring shall be extended to the equipment, and proper connections made thereto.

END OF SECTION 26 17 00

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SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. Conditions of the Contract and General Requirements are hereby made a part of this section.
- B. Provide lighting fixtures, lamps, and accessories for interior and exterior illumination of the building.

1.2 QUALITY ASSURANCE:

- A. Manufacturers: Exceptions to manufacturers listed with each item shall be made in accordance with the General Requirements.
- B. Laboratory Testing: Photometric testing shall be by Independent Testing Laboratories, Inc., based on Illuminating Engineering Society published procedures, and shall include candlepower distribution tabulation and zonal cavity coefficient of utilization tabulation.
- C. Standards:
 - 1. All lighting fixtures shall meet Underwriters' Laboratories, Inc., applicable standards.
 - 2. Fixtures shall be provided possessing Underwriters' Laboratories location duty listings as required by the specific application.
 - a. Exposed Outdoors - Wet Location
 - b. Sheltered Outdoors - Damp location
- D. NEC Compliance: Comply with the NEC as applicable to the installation and construction of lighting fixtures.
- E. NEMA Compliance: Comply with applicable requirements of NEMA Standard Pub. Nos. LE-1 and LE-2 pertaining to lighting equipment.
- F. ANSI/UL Compliance: Comply with ANSI/UL Standards pertaining to interior and exterior lighting fixtures for hazardous locations.
- G. UL Compliance: Provide light fixtures that have been UL listed and labeled.

1.3 SUBMITTALS:

- A. Submit manufacturer's literature giving materials, finishes, dimensions, coefficients of utilization, and lamp types for each fixture which is the product of one of the listed acceptable manufacturers.

- B. Submit samples of fixtures upon specific request.
- C. See Section 26 01 00.

1.4 CERTIFICATES:

- A. Labels of Underwriters' Laboratories, Inc.; Certified Ballasts Manufacturers, and Electrical Testing Laboratories affixed to each item of material.

PART 2 - PRODUCTS

2.1 ACCEPTABLE FIXTURE MANUFACTURERS:

- A. Listed in schedule and with materials.
- B. Substitutions: If the Contractor proposes to substitute lighting fixtures for those shown on the drawings or specified herein, he shall submit a list of proposed fixtures together with technical data to substantiate that the substitute fixtures are equivalent in all respects to the specified equipment. Proposed substitute fixtures must be submitted to the architect/engineer for review a minimum of ten (10) days prior to the project bid date. Only original documentation will be accepted for review. Copies sent via facsimile or e-mail will not be accepted. After review of the proposed substitute fixtures, an addendum may be issued to include acceptable equipment. The review of substitute equipment in no way relieves the contractor of the responsibility to provide equipment that is equivalent in all respects to specified fixtures. Lighting fixtures as shown on the drawings or specified herein shall be used as a basis and standard of comparison in the review and consideration of fixtures of other manufacturers. The Architect/Engineer shall have the final authority as to whether the fixture is equivalent to the specified item. The proposed substitution may be rejected for the aesthetic value if felt necessary or desirable. In the event the proposed substitutions are rejected, the Contractor shall furnish the specified item

2.2 LED LIGHT FIXTURES:

- A. Product Requirements -
 1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 2. Each luminaire shall be rated for a minimum operational life of greater than or equal to 50,000 hours as defined by IES LM-80 and TM-21.
 3. Each luminaire shall be designed to operate at an average operating temperature of 25°C.
 4. The operating temperature range shall be 10°C to +25°C.
 5. Some parameters and tests (such as IESNA standard LM-80-08) shall be conducted at different ambient temperatures.
 6. Each luminaire shall meet all parameters of this specification throughout the minimum operational life when operated at the average operating temperature.
 7. The individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.

8. Each luminaire shall be listed with a nationally recognized testing laboratory (including but not limited to UL, CSA, ETL) under UL 1598 and UL 8750, or an equivalent standard from a recognized testing laboratory.

B. Technical Requirements –

1. Electrical:

- a. Power Efficacy: Minimum power efficacy allowed for the luminaire shall be 85 Lumens per Watt at an input voltage of 277 VAC.
- b. Operation Voltage
 - 1) The luminaire shall operate from a 60 HZ \pm 3 HZ AC line over a voltage ranging from 110 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
 - 2) The standard operating voltages are 120 VAC, 277 VAC.
- c. Power Factor: The luminaire shall have a power factor of 0.90 or greater at all standard operating voltages
- d. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage.
- e. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference.
 - 1) The surge protection which may reside within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 1991 for Location Category A Low. Where failure does not mean a momentary loss of light during the transient event.
- f. Operational Performance: The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.
- g. RF Interference: The luminaire and associated onboard circuitry must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
- h. Dimming: The luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 5% of rated lumen output, unless scheduled otherwise. Dimming shall be controlled by a 0-10V signal.

C. Photometric Requirements -

1. Light Output

- a. The manufacture shall publish initial lumen output of the luminaire in the 0-90 degree zone - as measured by IESNA Standard LM-79-08.
- b. Projected L70 life shall be at least 50,000 hrs based on IESNA TM-21 calculations performed using IESNA LM-80 test data.
- c. The measurements shall be calibrated to standard photopic calibrations.

2. Light Color/Quality.

- a. Corrected Color temperature (CCT) range between 3,500K and 4,100K shall be correlated to chromaticity as defined by the absolute (X,Y) coordinates on the 2-D CIE chromaticity chart.
- b. The color rendition index (CRI) shall be 80 or greater.

D. Thermal Management -

1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the rated minimum operational life.
 - a. The LED manufacturer's maximum junction temperature for the rated minimum operational life shall not be exceeded at the average operating ambient.
 - b. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient.
 - c. The luminaire shall have an UL IC rating, if recessed into an insulated ceiling.
2. The Driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design.
 - a. The use of fans or other mechanical devices shall not be allowed.

E. Physical and Mechanical Requirements -

1. The luminaire shall be a single, self-contained device, not requiring onsite assembly for installation. The power supply for the luminaire shall be integral to the unit.
2. The assembly and manufacturing process for the luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.
3. The optical assembly of the luminaire shall assure individual LED image are not visible to the occupant.
4. The electronics/power supply enclosure shall be internal to the luminaire and be accessible per UL requirements
5. The circuit board and power supply shall be contained inside the luminaire.
6. Electrical connections between normal power, driver and LED boards must be modular. All electrical components must be easily accessible after installation from the room side and all electrical components must to be able to be replaced without removing the fixture from the ceiling.
7. Housings shall be fabricated from post or pre-painted aluminum or cold rolled steel.
 - a. Each refractor or lens shall be made from UV inhibited high impact plastic (such as acrylic or polycarbonate) or heat and impact resistant glass,
 - b. Polymeric materials (if used) of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. The lenses (lens) of the luminaire are excluded from this requirement.

- F. Acceptable Manufacturers – Lithonia, Williams, Cooper, Visa, as scheduled, or approved equivalent.

2.3 ACCESSORIES:

- A. Manufacturers' standard mounting ring, trim flanges, hanger bars, spacers, supports, plaster frames of non-ferrous material or cadmium plated steel. Do not use painted steel plaster frames.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Inspect Architectural drawings and specifications.
- B. Inspect Architectural reflected ceiling plans.
- C. Inspect installed ceiling components and construction for defects affecting the quality and execution of work.

3.2 PREPARATION:

- A. Utilize Architectural drawings and specifications to determine ceiling material to be installed.
- B. Verify ceiling material and alignment.
- C. Layout exact locations of fixtures in accordance with reflected ceiling plans, fixtures' and switches' outlet boxes and supports.
- D. Provide outlet boxes and conduit.
- E. Provide fixture trim and hardware appropriate for architecturally selected ceiling materials.
- F. Provide appropriate hardware to support outlet boxes from structure. Support light fixtures directly from building structure in accordance with Uniform Building Code Standard 25- 2.

3.3 INSTALLATION:

- A. Provide lighting fixtures, lamps, switches, and control systems, and wiring.
- B. If designation omitted on drawings, provide same type fixtures employed in rooms of similar usage.
- C. Provide spacers for fixtures mounted on low density ceiling material.
- D. Provide plaster frames for recessed fixtures in plaster ceilings.
- E. Install fixtures in and on acoustical tile ceilings in alignment with tile joints.
- F. Install fixtures in fiber decking and form board so outlet boxes and openings will not be sight exposed.

- G. Prepare fixtures and trim required to be painted. Refer to other Section.
- H. Note: Outlet boxes locations on drawings are diagrammatic only. Position outlet boxes to coincide with suspension hangers and knockouts.
- I. Install in accordance with manufacturer's instructions, submittal data, and details on the drawings.

3.4 ADJUSTMENT AND CLEANING:

- A. Adjustment: Adjust lamp positions for desired effects. Align fixtures with building walls and tile joints.
- B. Cleaning: Remove dirt, grease, and foreign materials from interior and exposed surfaces of all fixtures.

3.5 LIGHTING FIXTURE SCHEDULE: Refer to drawings for fixture schedule.

END OF SECTION 26 50 00

SECTION 27 88 00 - INTERCOM SYSTEMS**PART 1 - GENERAL****1.1 SCOPE:**

- A. This specification provides the requirements for the installation, programming and configuration for the extension of the existing Dukane StarCall intercom system and Sapling clock system to accommodate the new intercom and clock system devices in the new building. All existing intercom and clock system headend equipment, cabling, speakers and call-in switches shall remain and be reused. The system shall include, but not limited to: head end equipment, network repeater, speakers, call-in switches, and clocks as shown on the plans, and all other equipment necessary to provide a complete and operating system.
- B. The intercom system shall, as a minimum, incorporate all new devices shown on the plans.
- C. The Communication system shall provide distribution of intercom, overhead paging, emergency paging, class change time tones, emergency tone and program material to new intercom devices in the new building.
- D. New intercom headend equipment shall be installed into the existing Dukane Star Call card cage.
- E. The requirements of Section 26 01 00, Basic Electrical Requirements, apply to this work.

1.2 QUALITY ASSURANCE:

- A. Equipment:
 - 1. Equipment assemblies shall be factory assembled and tested as a complete unit to meet the requirements of this system.
 - 2. All equipment shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.
 - 3. The Manufacturer shall be a nationally recognized company specializing in intercom systems. This organization shall employ factory trained technicians, and shall maintain a service organization within 100 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the intercom systems industry.
 - 4. Manufacturers/model numbers listed herein shall be the basis of design. Equivalent equipment provided by acceptable manufacturers may be submitted for approval.
 - 5. Acceptable Manufacturers: Dukane by Carehawk, Bogen, Simplex.
- B. Bidders:
 - 1. Bids by Wholesalers, Contractors, Franchised Dealers or any firm whose principal business is not that of manufacturing or installing intercom systems shall not be acceptable.
 - 2. The bidder shall have an in-place support facility with technical staff, spare parts inventory and all necessary test and diagnostic equipment. The installer shall have a

resident fully qualified service organization equipped for on-site maintenance and repair within a 100 mile radius of the site.

C. Installer:

1. The system shall be installed by competent technicians, regularly employed by the intercom manufacturer with full responsibility for proper operation of the intercom system including debugging and proper calibration of each component in the entire system.
2. Supplier and installer shall be able to refer to similar installations in the immediate area furnished and serviced by him during the past three years, providing satisfactory service.
3. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.
4. Manufacturer's Representative: Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.

1.3 SUBMITTALS:

- A. Shop Drawings: Submit manufacturer's literature completely describing intercom system components, equipment, and accessories, and shop drawings illustrating system interconnecting wiring and connections.
1. The contractor shall include the following information in the equipment submittal:
 - a. Complete wiring diagrams that illustrate the wiring requirements for each component in the proposed system.
 - b. Equipment list of all proposed devices and equipment.
 - c. Manufacturer's catalog data cut sheets on all equipment being provided for a fully functional system.
 - d. Software and firmware as required to provide a complete functioning system.
 - e. FCC registration number.
- B. Instructions: Furnish Instruction Manual describing operation of intercom system.
- C. Documentation:
1. Software documentation including description of programmed operation.
 2. Submit maintenance brochure after completion of the project. Maintenance brochure shall include operating instructions, specifications, and instruction sheets for the equipment.
 3. A complete list identifying all specific deviations from the specified system components and operation.
- D. See Section 26 01 00.

PART 2 - PRODUCTS

2.1 VOICE COMMUNICATION AND SOUND SYSTEM:

- A. Furnish and install all equipment to extend the existing Dukane StarCall microprocessor controlled voice communication system with all conduit, wire, outlets and equipment as shown on the drawings and as herein specified to provide a complete intercom, program and tone distribution and clock system in the new building.

2.2 SYSTEM EQUIPMENT:

1. considered.
- B. CALL-IN SWITCH
1. Call-in switches shall be a Carehawk model CS25 call station.
 2. The CS25 uses a momentary call-in switch to initiate a normal intercom call (single press) or an emergency intercom call (double press) that is received by the existing Dukane StarCall intercom system.
 3. The CS25 provides pigtail connectivity.
 4. Construction is a rocker-type push button mounted to brushed stainless steel plate for durability.
- C. LOUDSPEAKERS, BAFFLES AND BACKBOXES
1. Horn Type Speakers
 - a. The horn shall be equivalent to Lowell Model LH-15TA, which shall be a double reentrant design with a high efficiency 15W compression driver, round bell and universal swivel-style base. Power rating shall be 15 watts continuous. Frequency response shall be 537Hz-4.5kHz (+6dB) with a sensitivity of 112.2dB log average (1W/1M) 124.0dB maximum SPL (calculated based on power rating and measured sensitivity). Dispersion shall be 50 degrees conical (2kHz Octave Band). Impedance shall be 5000, 2500, 1300, 670, 330, 90, 45 ohms. Horn shall include a 25/70/100V transformer with screwdriver selectable taps. Taps for 25V use shall be: .13, .25, .48, .93, 1.9, 6.9, and 13.9W. Taps for 70V use shall be: 1, 2, 3.8, 7.5, and 15W. Taps for 100V use shall be: 2, 4, 7.7 and 15W. Transformer connections shall be protected by a plastic cover with strain relief. The horn assembly shall measure 8.94" dia. x 9.38" deep and shall be weather-resistant metal construction painted in corrosion-resistant beige epoxy.
- D. CLOCKS
1. Analog Clocks
 - a. The analog clock shall be equivalent to Sapling model SAL-2BS-12R-0 wireless battery operated clock with a black hour hand, a black minute hand, and a red second hand. The clock will be capable of receiving and then re-transmitting a signal from any other Sapling device that transmits data using Sapling's wireless protocol. The clock shall use frequency-hopping technology to receive time data on a frequency range of 915-928 MHz. The clock shall also be able to retransmit time data on the same frequencies. The frequency-hopping technology shall allow the clock to transmit time data without causing interference to other wireless devices that may be transmitting at the same time. The clock shall be designed to be used with the Sapling SMA Series Master Clock (with the transmitter option

installed) or the Sapling Repeater. Time data shall be transmitted and received by the clock via Sapling's wireless communication protocol. The clock shall also be designed to receive and retransmit time data to Sapling's SBL Series clocks and other SAL Series clocks. Upon receipt of the wireless signal, the clock will immediately self-correct. The clock's transmitter shall be able to successfully transmit data over a line-of-sight, unobstructed distance of up to 1320 feet.

- b. The clock shall include an executable method for automatic hand calibration, as well as a diagnostic function that allows the user to view the quality of the signal, the last time the clock received a correction signal, the performance and results of a gearbox test, and a comprehensive analysis of the entire clock movement. These diagnostic functions shall be enabled by pressing a button on the clock movement.
- c. The clock shall require fewer than five (5) minutes to perform a correction of the hand positions.
- d. The clock shall be capable of receiving a time and correction signal every two (2) hours in standard mode and every four (4) hours in economy mode.
- e. The battery life of the clock shall be five (5) hours in standard mode and eight (8) hours in economy mode.
- f. The clock shall have a smooth surface ABS case which can be attached either directly to the wall, or to a standard-sized gang box.
- g. The crystal is to be made of shatterproof, side molded polycarbonate.
- h. The clock shall be FCC compliant, in accordance with part 15 Section 15,247.
- i. Analog clocks shall be set to operate in the economy mode.
- j. Batteries for wireless battery operated clocks shall be included as part of this bid.

E. NETWORK REPEATER

1. The repeater shall be a Sapling model SMA-1SM- 0000-1 Network Repeater. It shall receive time data via TCP/IP from the existing Sapling Master Clock. The repeater shall transmit data on a frequency of 915-928 MHz. This will allow it to communicate with wireless SAL Analog and SBL Digital clocks operating on the same frequency range using frequency-hopping technology. The repeater shall have a maximum antenna size of seven (7) inches, an RF input sensitivity of -103dbm, a power output of 27 dBm, and shall be FCC approved. The voltage input for the repeater shall be 115V/60Hz or 230V/50Hz.

F. WIRE AND CABLE

1. Plenum rated cable as specified by product manufacture.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. The Intercom system shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner. The Contractor shall be responsible for all electrical installation required for a fully functional intercom system. All wiring shall be in accordance to all local and national codes. All line voltage wiring and all wiring in equipment rooms shall be installed in conduit and in accordance with NEC and local codes.
 1. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of intercom systems.

- B. Provide and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations.
1. All intercom system wiring shall be in a completely separate conduit system, except where cable is allowed below. All circuitry shall be concealed in walls and above ceilings.
 2. Wiring color code shall be maintained throughout the installation. All new wiring shall have each conductor tagged and identified. Wiring for like functions shall be color-coded consistently throughout the systems.
 3. Verify all circuiting requirements with equipment manufacturer before installation.
- C. All circuitry shall be properly supported and run in a neat and workmanlike manner. All circuitry shall run parallel to or at right angles to the building structure. All wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All electronic wiring shall be type and size as recommended by system manufacturer.
1. Where installed above accessible ceilings, intercom cabling may be installed in a neat manner, tightly bundled and independently secured to building structure by approved means. Do not lay cable on ceiling and do not support from other conduit systems, ductwork or piping. Utilize plenum rated cable in return air plenums.
 2. Where devices are to be installed on, or cabling is to pass through frame walls or hollow masonry walls the cabling shall be fished in the wall cavity to an appropriate flush outlet box firmly mounted in the wall.
 3. Where devices are to be installed on or cabling is to be routed over solid masonry walls the cabling shall be installed in approved surface mounted raceways equal to Wiremold or equivalent. Where installed in rooms with accessible ceilings the surface raceways shall be routed vertically from the ceiling to the device in a neat and workman like manner. Verify all routing of surface raceways with the Architect.
 4. Where approved surface mounted raceways are used, the device mounting boxes shall be finished surface boxes of suitable size for the device installation.
- D. Labor to troubleshoot, repair, reprogram, or replace system components shall be furnished by the intercom contractor at no charge to the Owner during the warranty period.
- E. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.
- F. The intercom contractor shall maintain electronic copies of all data file and application software for reload use in the event of a system crash or memory failure. One copy shall be delivered to the Owner during training session, and one copy shall be archived by the intercom manufacturer.
- G. The contractor shall clean all dirt and debris from the inside and the outside of all system equipment after completion of the installation.

3.2 CLEANING:

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

3.3 FIELD QUALITY CONTROL AND TESTING:

- A. **Manufacturer's Field Services:** Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
 - 1. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of intercom systems.
- B. **Coordinate the testing during occupied hours with the Owner to minimize disruption of the daily schedule.**
- C. **Pretesting:** Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
- D. **Final Test Notice:** Provide a 10-day minimum notice in writing to the Architect when the system is ready for final acceptance testing.
- E. **Retesting:** Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- F. **Report of Tests and Inspections:** Provide a written record of inspections, tests, and detailed test results in the form of a test log.

3.4 INSTRUCTION:

- A. All training shall be by the Intercom manufacturer's trained representative and shall utilize Operation and Maintenance manuals and as-built documentation. Manual documentation shall include:
 - 1. Operation sequences with specific to specific hardware components - Wiring diagrams
 - 2. System software documentation.
 - 3. Operation instructions.
 - 4. Maintenance instructions.
 - 5. Troubleshooting instructions.
- B. Following the completion of work, the Owner's representative shall be given a minimum of two (2) two hour sessions of instructions on operation and maintenance of the completed system. Training topics shall include:
 - 1. Sequence of Operation review.
 - a. Operating station equipment.
 - b. Administrative devices.
 - c. User programming functions.
 - d. Program distribution equipment.
- C. Deliver to the Owner at the time of the first training session three complete Operation and Maintenance Manuals.

3.5 WARRANTY:

- A. The contractor shall warrant the completed intercom system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of the completed and certified test or from the date of first beneficial use.
- B. A representative of the manufacturer shall provide at least two inspections of the complete system during the one year warranty period.
- C. Labor to troubleshoot, repair, reprogram, or replace system components shall be furnished by the intercom contractor at no charge to the Owner during the warranty period.
- D. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks. All firmware or resident software updates and new releases shall be supplied and installed free of charge for two years after the project warranty is expired.
- E. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72H guidelines, to begin after the warranty period expires.

END OF SECTION 27 88 00

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SECTION 28 72 10 - FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 SCOPE:

- A. This specification provides the requirements for the installation, programming and configuration of a complete Addressable Fire Alarm System. The system shall include, but not limited to: fire alarm control panel, power extenders where required, automatic and manually activated alarm initiating and notification peripheral devices, conduit and wiring, software and accessories required to furnish a complete and operational Life Safety System. The installed Fire Alarm System shall provide complete automatic and manual fire detection and alarm notification as required for this facility.
- B. The complete installation shall conform to the applicable sections of NFPA-72, Local Code Requirements and National Electrical Code [Article 760].
- C. System shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.
- D. The fire alarm control panel shall, as a minimum, incorporate all new devices shown on the plans.
- E. The requirements of Section 26 01 00, Basic Electrical Requirements, apply to this work.

1.2 FIRE ALARM SYSTEM DESCRIPTION:

- A. General: Provide a complete, addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
- B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
- C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history.
- D. Wiring/Signal Transmission:
 - 1. Transmission shall be hard-wired, using separate individual circuits for each zone of alarm operation as required or addressable signal transmission, dedicated to fire alarm service only.
 - 2. System connections for initiating, signaling line circuits and notification appliance circuits shall be Class B.

3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- E. Remote Access:
1. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.
 2. FACP shall have the capability to provide third party access through a serial interface connection and be agency listed for specific interfaces and for the purpose.
- F. Required Functions: The following are required system functions and operating features:
1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
 2. Noninterfering: An event on any initiating addressable device does not prevent the receipt of signals from any initiating devices. All addressable initiating devices are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.
 3. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator, indicating the location and type of device.
 4. General Alarm: A system general alarm shall include:
 - a. Indication of alarm condition at the FACP and the annunciator(s).
 - b. Identification of the device /zone that is the source of the alarm at the FACP and the annunciator(s).
 - c. Operation of audible and visible notification devices throughout the building until silenced at FACP.
 - d. Closing doors normally held open by magnetic door holders.
 - e. Unlocking designated doors.
 - f. Shutting down supply and return fans serving zone where alarm is initiated.
 - g. Closing smoke dampers on system serving zone where alarm is initiated.
 - h. Notifying the local fire department.
 5. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
 - a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
 - b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
 - c. Record the event in the FACP historical log.
 - d. Transmission of supervisory signal to remote central station.

- e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.
 6. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible [and visible] alarm signals shall cease operation.
 7. System Reset
 - a. The "System Reset" button shall be used to return the system to its normal state.
 - b. Should an alarm condition continue, the system will remain in an alarmed state.
 8. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.
 9. WALKTEST: "One Person Testing" mode of the system as follows:
 - a. The city circuit connection and any suppression release circuits shall be bypassed.
 - b. Control relay functions associated to one of the 8 testing groups shall be bypassed.
 - c. The control unit shall indicate a trouble condition.
 - d. The unit shall automatically reset itself after signaling is complete.
 - e. Any opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
- G. Analog Smoke Sensors:
1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.
 2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
 3. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a CRT Display or printed for annual recording and logging of the calibration maintenance schedule.
 4. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning.
 5. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.]
- H. Audible Alarm Notification: By horns and horn/strobe units in areas as indicated on drawings.
- I. Fire Suppression Monitoring:
1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
 2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
- J. Power Requirements
1. The control unit shall receive AC power via a dedicated fused disconnect circuit.

2. The Fire Alarm system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously at the user interface while incoming power is present.
5. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
6. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.
7. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
8. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

1.3 QUALITY ASSURANCE:

A. Equipment:

1. Equipment cabinet assemblies shall be factory assembled and tested as a complete unit to meet the requirements of this system.
2. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.
3. The Manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems. This organization shall employ factory trained and NICET certified technicians, and shall maintain a service organization within 100 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.
4. Fire alarm systems by the manufacturers listed below will be considered. Being listed as an acceptable Manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.
5. Acceptable Manufacturers: Honeywell Inc., Fire Lite, Gamewell, Notifier, Siemens, Silent Knight, Simplex Grinnell.

B. Bidders:

1. Bids by Wholesalers, Contractors, Franchised Dealers or any firm whose principal business is not that of manufacturing or installing fire alarm systems shall not be acceptable.
2. The bidder shall have an in-place support facility with technical staff, spare parts inventory and all necessary test and diagnostic equipment. The installer shall have a resident fully qualified service organization equipped for on-site maintenance and repair within a 100 mile radius of the site.

C. Installer:

1. The system shall be installed by competent electricians, regularly employed by the fire alarm manufacturer with full responsibility for proper operation of the fire management system including debugging and proper calibration of each component in the entire system.
2. Supplier and installer shall be able to refer to similar installations in the immediate area furnished and serviced by him during the past three years, providing satisfactory service.
3. The contractor shall employ on staff a minimum of one NICET level II technician or a professional engineer, registered in the State of the installation.
4. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.
5. Manufacturer's Representative: Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be licensed in the State if required by law. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
6. The final checkout and verification of the Fire Alarm system shall be conducted by a technician certified by the National Institute for Certification in Engineering Technologies (NICET). This technician shall be registered as level 2 or higher in the fire protection technology certification program. Provide NICET certification information with fire alarm submittal.

D. Codes and Approvals:

1. The complete fire management installation shall be in strict accordance to the Uniform Fire Code and all local and state codes having jurisdiction for fire alarm/life safety systems. All devices designed for or used in line voltage applications shall be UL listed.
2. All microprocessor based remote devices shall be UL916 and UL864 Listed.
3. All fire management central equipment shall be UL916 Listed.
4. Other fire alarm equipment shall be listed under the appropriate following UL standards.

- E. All system components shall be fault tolerant. They shall provide satisfactory operation without damage at 110% of rated voltage and at ± 3 hertz variation in line frequency. Provide static, transient, and short circuit protection on all inputs and outputs as required. Communication lines shall be protected against incorrect wiring, static transients and induced magnetic interference. Bus connected devices shall be ac coupled or equipped with equivalent preventative measures so that any single device failure will not disrupt or halt bus communication.

1.4 SUBMITTALS:

- A. Shop Drawings: Submit manufacturer's literature completely describing fire alarm system components, equipment, and accessories, and shop drawings illustrating system interconnecting wiring and connections.
1. The contractor shall include the following information in the equipment submittal:
 - a. AutoCAD floor plans and complete wiring diagrams that illustrate the wiring requirements for each component in the proposed system.
 - b. Power calculations including battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement.
 - c. Equipment list of all proposed devices and equipment.
 - d. Manufacturer's catalog data cut sheets on all equipment being provided for a fully functional system.
 - e. Software and firmware as required to provide a complete functioning system.
 2. When required by the State Fire Marshal, Fire Alarm Shop Drawings shall bear the stamp of an engineer licensed in the State of Kansas.
- B. Instructions: Furnish Instruction Manual describing operation of fire alarm system.
- C. Documentation:
1. Software documentation including description of programmed operation.
 2. Submit maintenance brochure after completion of the project. Maintenance brochure shall include operating instructions, specifications, and instruction sheets for the equipment.
 3. A complete list identifying all specific deviations from the specified system components and operation.
 4. See Section 26 01 00 for additional requirements.

1.5 EXTRA MATERIALS:

- A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:
- B. Horn, Strobe, and Combination Units: Furnish quantity equal to 10 percent of the number of each type of unit installed, but not less than one.
- C. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.
- D. Detector or Sensor Bases: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANEL (FACP):

- A. General: Comply with UL 864, "Control Units for Fire-Protective Signaling Systems."
- B. The following FACP hardware shall be provided:
 - 1. Power Limited base panel with cabinet and door, 120 VAC input power.
 - 2. Minimum point capacity of 200% of designed system's point count, or a minimum capacity of 50 points, whichever is larger. Points shall include any addressable initiating devices.
 - 3. Provide a digital dialer in compliance with 2012 International Building Code requirements.
 - 4. Programmable DACT for either Common Event Reporting or per Point Reporting.
- C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
 - 1. Cabinet color: red.
- D. Alphanumeric Display and System Controls: Panel shall include an 80 character LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.

2.2 EMERGENCY POWER SUPPLY:

- A. General: Components include battery, charger, and an automatic transfer switch.
- B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm indicating devices in alarm or supervisory mode for a period of 5 minutes.

2.3 REMOTE ANNUNCIATOR:

- A. Provide where required a remote LCD Annunciator with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.
- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.
- C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
 - 1. 40 character custom location label.
 - 2. Type of device (e.g., smoke, pull station, waterflow).
 - 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.
- G. Device color: red.

2.4 ADDRESSABLE MANUAL PULL STATIONS:

- A. Description: Addressable single- or double-action type, LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.
- B. Device color: red.

2.5 SMOKE SENSORS:

- A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
 - 1. Factory Nameplate: Serial number and type identification.
 - 2. Operating Voltage: 24 VDC, nominal.
 - 3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
 - 4. Each sensor base shall contain an LED that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.
 - 5. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type.
 - 6. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
 - 7. Sensors include a communication transmitter and receiver having a unique identification and capability for status reporting to the FACP.
- B. Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Relay output, sounder and isolator bases shall be supported alternatives to the standard base.
- D. Duct Smoke Sensor: Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.

1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
 2. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
 3. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
- E. Device color: red.

2.6 HEAT SENSORS:

- A. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.
- B. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.
- C. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing.
- D. Device color: red.

2.7 ADDRESSABLE CIRCUIT INTERFACE MODULES:

- A. Addressable Circuit Interface Modules: Arrange to monitor one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of water flow, valve tamper, non-addressable devices, and for control of evacuation indicating appliances and AHU systems.
- B. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.
- C. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.8 MAGNETIC DOOR HOLDERS: None are used.

2.9 STANDARD ALARM NOTIFICATION APPLIANCES:

- A. Horn: Piezoelectric type horn shall be listed to UL 464. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.

- B. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- C. Audible/Visible: Combination Audible/Visible (A/V) Notification. Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. Devices installed outdoors shall be weatherproof.
- D. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.
- E. For outdoor hazardous locations, provide weatherproof devices meeting the requirements of NFPA National Electrical Code.
- F. Device color: red.
- G. Accessories: The contractor shall furnish the necessary accessories.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. The fire alarm system shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner. The Contractor shall be responsible for all electrical installation required for a fully functional fire alarm system. All wiring shall be in accordance to all local and national codes. All line voltage wiring and all wiring in equipment rooms shall be installed in conduit and in accordance with NEC and local codes.
- B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:
 - 1. Factory trained and certified personnel.
 - 2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
 - 3. Personnel licensed or certified by state or local authority.
- C. Provide and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations.

1. All fire alarm system wiring shall be in a completely separate conduit system, except where cable is allowed below. All junction boxes shall be sprayed red and labeled "Fire Alarm". All circuitry shall be concealed in walls and above ceilings where the structure is not exposed.
 2. Wiring color code shall be maintained throughout the installation. All new wiring shall have each conductor tagged and identified. Wiring for like functions shall be color-coded consistently throughout the systems.
 3. Verify all circuiting requirements with equipment manufacturer before installation.
- D. Provide interconnecting wiring from fire alarm systems control outputs to controlled devices and equipment. Provide connection of power supplies and or transformers for powering controlled device operators.
1. Provide connections for operation and wiring from output contacts to smoke dampers operators.
- E. Equipment Installation:
1. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.
 2. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.
 3. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.
 4. Do not install any area smoke sensor within 3 feet of an air supply or return grille.
- F. Wiring Installation:
1. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).
 2. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
 3. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.
- G. All circuitry shall be properly supported and run in a neat and workmanlike manner. All circuitry shall run parallel to or at right angles to the building structure. All wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All electronic wiring shall be type and size as recommended by system manufacturer.

1. Where installed above accessible ceilings, fire alarm cabling may be installed in a neat manner, tightly bundled and independently secured to building structure by approved means. Do not lay cable on ceiling and do not support from other conduit systems, ductwork or piping. Utilize plenum rated cable in return air plenums.
 2. Where devices are to be installed on, or cabling is to pass through frame walls or hollow masonry walls the cabling shall be fished in the wall cavity to an appropriate flush outlet box firmly mounted in the wall.
 3. Where devices are to be installed on or cabling is to be routed over solid masonry walls the cabling shall be installed in approved surface mounted raceways equal to Wiremold or equivalent. Where installed in rooms with accessible ceilings the surface raceways shall be routed vertically from the ceiling to the device in a neat and workman like manner. Verify all routing of surface raceways with the Architect.
 4. Where approved surface mounted raceways are used, the device mounting boxes shall be finished surface boxes of suitable size for the device installation.
- H. Labor to troubleshoot, repair, reprogram, or replace system components shall be furnished by the fire alarm contractor at no charge to the Owner during the warranty period.
- I. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.
- J. The Fire Alarm Contractor shall maintain electronic copies of all data file and application software for reload use in the event of a system crash or memory failure. One copy shall be delivered to the Owner during training session, and one copy shall be archived by the fire alarm manufacturer.
- K. The contractor shall clean all dirt and debris from the inside and the outside of all system equipment after completion of the installation.
- L. Install additional audio/visual units in locations indicated to have inadequate sound levels based on the sound level testing.

3.2 CLEANING AND ADJUSTING:

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.
- C. Do not install smoke detectors before the status of construction and clean-up meets the requirements of NFPA. Clean all smoke detectors at the completion of the construction work. Produce a log of all smoke detector sensitivity levels at system start-up and deliver to the Owner.

3.3 FIELD QUALITY CONTROL AND TESTING:

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
- B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
 - 1. Factory trained and certified.
 - 2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
 - 3. International Municipal Signal Association (IMSA) fire alarm certified.
 - 4. Certified by a state or local authority.
 - 5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
- C. Coordinate the testing during occupied hours with the Owner to minimize disruption of the daily schedule.
- D. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
- E. Final Test Notice: Provide a 10-day minimum notice in writing to the Architect when the system is ready for final acceptance testing.
- F. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.
- G. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- H. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.
- I. Final Test, Certificate of Completion, and Certificate of Occupancy:
 - 1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.

3.4 INSTRUCTION:

- A. All training shall be by the Fire Alarm manufacturer's trained representative and shall utilize Operation and Maintenance manuals and as-built documentation. Manual documentation shall include:
 - 1. Operation sequences with specific to specific hardware components - Wiring diagrams
 - 2. System software documentation
 - 3. Control Panel operation instructions

4. Maintenance instructions
 5. Troubleshooting instructions
- B. Following the completion of work, the Owner's representative shall be given a minimum of two (2) two hour sessions of instructions on operation and maintenance of the completed system. Training topics shall include:
1. Sequence of Operation review.
 2. Sign on-Sign off.
 3. Interpretation and selection of displays and reports.
 4. Modifying English text.
 5. Modifying alarm limits and start-stop times.
 6. System initialization.
 7. Purge and/or dump of historical data.
 8. Troubleshooting of sensors (determining bad sensors).
 9. Troubleshooting and selection of notification devices
- C. Deliver to the Owner at the time of the first training session three complete Operation and Maintenance Manuals.

3.5 WARRANTY:

- A. The contractor shall warrant the completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of the completed and certified test or from the date of first beneficial use.
- B. A representative of the manufacturer shall provide at least two inspections of the complete system during the one year warranty period.
- C. Labor to troubleshoot, repair, reprogram, or replace system components shall be furnished by the Fire Alarm contractor at no charge to the Owner during the warranty period.
- D. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks. All firmware or resident software updates and new releases shall be supplied and installed free of charge for two years after the project warranty is expired.
- E. The equipment manufacturer shall make available to the Owner a maintenance contract proposal to provide a minimum of two (2) inspections and tests per year in compliance with NFPA-72H guidelines, to begin after the warranty period expires.

END OF SECTION 28 72 10

SECTION 31 20 00 - EARTH MOVING**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
1. Excavating and filling for rough grading the Site.
 2. Preparing subgrades for slabs-on-grade, walks, and pavements.
 3. Excavating and backfilling for buildings and structures.
 4. Drainage course for concrete slabs-on-grade.
 5. Subbase course for concrete walks and pavements.
 6. Subbase course and base course for asphalt paving.
 7. Subsurface drainage backfill for walls and trenches.
- B. Related Requirements:
1. Section 01 32 00 "Construction Progress Documentation" for recording preexcavation and earth-moving progress.
 2. Section 03 30 00 "Cast-in-Place Concrete" for vapor retarder installed above granular course and beneath the slab-on-grade.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving or cement concrete paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 - 1. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement.
- J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct preexcavation conference at Project site.
 - 1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
 - a. Personnel and equipment needed to make progress and avoid delays.
 - b. Coordination of Work with utility locator service.
 - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
 - d. Extent of trenching by hand or with air spade.
 - e. Field quality control.

1.5 ACTION 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. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: 12 by 12 inches (300 by 300 mm).

2. Warning Tape: 12 inches (300 mm) long; of each color.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 1. Classification according to ASTM D 2487.
 2. Laboratory compaction curve according to ASTM D 698.
- C. 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.

1.7 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 1. Do not proceed with work on adjoining property until directed by Architect.
- C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 01 50 00 "Temporary Facilities and Controls" are in place.
- E. The following practices are prohibited within protection zones:
 1. Storage of construction materials, debris, or excavated material.
 2. Parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.

5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 1.5 inches (38 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Groups GC, SC, and CL may be considered satisfactory if they meet the recommendations of the geotechnical report.
 2. Unsatisfactory soils also include satisfactory soils not maintained above optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with a maximum particle size of 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and zero to 5 percent passing a No. 8 (2.36-mm) sieve.

- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- L. Low Volume Change Material (LVC): Consist of material with a liquid limit (LL) less than 40 and a plasticity index (PI) between 10 and 20; with minimum 15 percent passing a No. 200 sieve.

2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Survivability: As follows:
 - a. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
 - b. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
 - c. Tear Strength: 56 lbf (250 N); ASTM D 4533.
 - d. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
 - 3. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
 - 4. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Survivability: As follows:
 - a. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
 - b. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
 - c. Tear Strength: 90 lbf (400 N); ASTM D 4533.
 - d. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
 - 3. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
 - 4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:
1. Portland Cement: ASTM C 150/C 150M, Type I.
 2. Fly Ash: ASTM C 618, Class C or F.
 3. Normal-Weight Aggregate: ASTM C 33/C 33M, 3/4-inch (19-mm) nominal maximum aggregate size.
 4. Foaming Agent: ASTM C 869/C 869M.
 5. Water: ASTM C 94/C 94M.
- B. Produce low-density, controlled low-strength material with the following physical properties:
1. As-Cast Unit Weight: 30 to 36 lb/cu. ft. (480 to 576 kg/cu. m) at point of placement, when tested according to ASTM C 138/C 138M.
 2. Compressive Strength: 140 psi (965 kPa), when tested according to ASTM C 495/C 495M.

2.4 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) 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 (150 mm) wide and 4 mils (0.1 mm) 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 (750 mm) deep; colored as follows:
1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. 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.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Soils Engineer. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
 - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

- a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
 1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.
 1. Clearance: 12 inches (300 mm) each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.

3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 4. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 6 inches (150 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trenches in Tree- and Plant-Protection Zones:
1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade below the building slabs and pavements with a loaded 10-wheel, tandem-axle dump truck weighing not less than 20 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, 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, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 12 inches (300 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 03 30 00 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 6-inch- (150-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 6 inches (150 mm) of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 03 30 00 "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
 - 1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.

- a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
 2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.
- G. Final Backfill:
1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
 2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- H. Warning Tape: Install warning tape 12 inches (300 mm) directly above utilities.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
 2. Under walks and pavements, use satisfactory soil material.
 3. Under steps and ramps, use engineered fill.
 4. Under building slabs, use engineered fill.
 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to between optimum and 4 percent above optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 4 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 9 inches (239 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 9 inches (229 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 9 inches (229 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
 - 2. Walks: Plus or minus 1 inch (25 mm).
 - 3. Pavements: Plus or minus 1/2 inch (13 mm).
- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).
 - 1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
- B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick.

Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
2. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice. The top 9" of pavement subgrade should consist of LVC material or chemically stabilized on-site soils.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place base course material over subbase course under hot-mix asphalt pavement.
 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
 5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.19 UNDER SLAB ON GRADE FLOORS

- A. Minimum 2-inch (50 mm) sand base over a minimum 12 inch (300 mm) LVC soil layer, except 18 inches (450 mm) at High School and Science Wing addition. LVC soils should be placed in 9-inch (229 mm) lifts.
- B. Moisture content of upper 9-inches (229 mm) of subgrade shall be checked prior to placement of the sand base. If subgrade is below optimum, subgrade shall be scarified, moisture conditioned, and recompacted prior to placement of sand base.
- C. Vapor Retarder: Install vapor retarder above granular course and beneath the slab-on-grade.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

- A. Special Inspections: 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 classification and maximum lift thickness comply with requirements.
 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.
 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length but no fewer than two tests.
 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.
- F. 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.

3.22 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
 - 1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

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SECTION 31 31 16 - TERMITE CONTROL**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Soil treatment.
- B. Related Requirements:
 - 1. Section 06 10 00 "Rough Carpentry" for wood preservative treatment by pressure process.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
 - 2. Include the EPA-Registered Label for termiticide products.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each type of termite control product.
- C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and 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. Sample Warranties: For special warranties.

1.6 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.

1.7 FIELD CONDITIONS

A. Soil Treatment:

1. 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.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.8 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, including Formosan termites (*Coptotermes formosanus*). 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 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 SOIL TREATMENT

- A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Bayer Environmental Science.
 - c. Ensysyex, Inc.
 - d. Syngenta.
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, 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 APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

GEOTECHNICAL EXPLORATION REPORT
Proposed High School Complex
Improvements
Wamego High School
Wamego, Kansas

GSI Project No. 1773023B
March 9, 2017

Prepared by:

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4503 East 47th Street South
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(316) 554-0725

Prepared for:

USD 320 Wamego School
District
1008 8th Street
Wamego, Kansas 66547

Important Information about This

Geotechnical-Engineering Report

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

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

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

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply this report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

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

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an

assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help

others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold-prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical-engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your GBC-Member geotechnical engineer for more information.



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TABLE OF CONTENTS

	<u>Page No.</u>
1. INTRODUCTION	1-1
1.1 General.....	1-1
1.2 Project Description.....	1-1
2. FIELD EXPLORATION	2-1
3. SITE CONDITIONS	3-1
3.1 Regional Geology	3-1
3.2 Surface Conditions.....	3-1
3.3 Subsurface Conditions.....	3-1
3.4 Groundwater Conditions	3-2
4. LABORATORY TESTING	4-1
5. CONCLUSIONS AND RECOMMENDATIONS	5-1
5.1 General Geotechnical Considerations.....	5-1
5.2 Earthwork	5-1
5.2.1 Site Preparation.....	5-1
5.2.2 General Structural Fill.....	5-2
5.2.3 Low Volume Change Material (LVC)	5-2
5.2.4 Compaction of Engineered Structural Fills.....	5-3
5.2.5 Utility Trench Backfill	5-3
5.2.6 Foundation Backfill	5-4
5.2.7 Correction of Unsuitable Foundation Soils.....	5-4
5.2.8 Excavation Slopes.....	5-5
5.3 Foundations	5-5
5.4 Floor Slabs	5-7
5.5 Pavement Recommendations	5-8
5.5.1 Pavement Subgrade Preparation.....	5-8
5.5.2 Recommended Design Sections	5-9
5.5.3 Asphaltic Cement Concrete Pavement Construction	5-10
5.5.4 General Pavement Considerations	5-10
5.6 Surface Drainage and Landscaping	5-11
5.7 Construction Considerations	5-12
5.8 Construction Observation and Quality Assurance	5-12
6. CLOSING REMARKS AND LIMITATIONS	6-1



APPENDICES

- Appendix A - General Vicinity Map
Boring Location Plan
- Appendix B - Boring Logs
Key to Symbols
Legend & Nomenclature
Unified Soil Classification System (USCS)
- Appendix C - Field & Laboratory Test Results



1. INTRODUCTION

1.1 General

This report summarizes the findings of our geotechnical exploration for the proposed Unified School District (USD) 320 High School complex located at 801 Lincoln Avenue in Wamego, Kansas. The scope of work was outlined in our proposal dated January 17, 2017. Mr. Patrick Schaub of USD 320 authorized this exploration on February 1, 2017.

The purpose of this geotechnical study is to explore the subsurface conditions at the proposed site with exploratory borings, evaluate the engineering properties of the subsurface materials with appropriate field and laboratory tests, and perform engineering analyses for developing design and construction recommendations for the proposed project.

1.2 Project Description

We understand the proposed project involves the construction of a new multipurpose building immediately west of the existing high school building and a new parking lot located at the northeast corner of 8th Street and Poplar Street. The proposed single-story multipurpose structure has a plan area of approximately 12,500 square feet. We understand the proposed structure will be of pre-engineered steel frame or pre-cast concrete panel construction with a concrete slab-on-grade first floor. We estimate that the structure will have maximum continuous wall loads on the order of 8 kips per lineal foot.

We estimate that cuts and fills of less than 2 feet will be required to prepare the new multipurpose building site and the parking lot site for construction.

We anticipate that the pavements will support predominately light passenger cars with less frequent panel delivery vans, passenger vans, buses, and trash trucks.

A site plan is included in Appendix A for reference.

2. FIELD EXPLORATION

We drilled seven borings for this geotechnical exploration on February 9, 2017 with a Mobile B-61 truck-mounted drilling rig using 3.25-inch inside diameter hollow stem augers. We drilled 4 borings within the building footprint to a depth of approximately 15 feet below the site grade at the time of our exploration. We drilled 3 borings in the parking area to a depth of approximately 10 feet below the site grade at the time of our exploration.

Boring locations were indicated on preliminary site sketch provided by Mr. Carl Riblett of BBN Architects. GSI personnel established field locations by measuring distances from reference points shown on this preliminary site plan. Locations of the borings in relation to existing and proposed features are indicated on the Boring Location Plan included in Appendix A. The locations of the borings should be considered accurate only to the degree implied by the methods used in their determination.

Our drill crew obtained soil samples at the intervals shown on the boring logs in Appendix B. Recovered samples were sealed in plastic containers, labeled, and protected for transportation to the laboratory for further examination, testing, and classification.

We obtained split-barrel samples (designated “Split Spoon” or “S” samples) while performing Standard Penetration Tests (SPT) with a 1-3/8 inch I.D. thick-walled sampler, driven using an automatic hammer in general accordance with ASTM D1586, “*Penetration Test and Split-Barrel Sampling of Soils.*” The “N” value, reported in blows per foot (bpf), equals the number of blows required to drive the sampler through the last 12 inches of the 18-inch sample interval using a 140-pound hammer falling 30 inches.

We obtained undisturbed samples (designated “Shelby Tube” or “U” samples) with 3-inch O.D. thin-walled tube samplers, hydraulically pushed in general accordance with ASTM D1587, “*Thin-Walled Tube Sampling of Soils for Geotechnical Purposes.*”

Our drilling personnel prepared field boring logs during drilling operations. These field logs report drilling and sampling methods, sampling intervals, groundwater measurements and the subsurface conditions we encountered. At the conclusion of drilling, our drill crew made groundwater measurements and backfilled the borings in accordance with Kansas state regulations.

3. SITE CONDITIONS

3.1 Regional Geology

This project lies within the Glaciated geomorphic region of northeast Kansas. The topography of this region was created by the advance of Ice Age glaciers and is characterized by steeply rolling hills with areas of level upland divides and alluvial lowlands. Soil stratigraphy generally consists of Pre-Illinoian glacial till (drift) overlain in some areas by loess deposits of varying thickness. Pre-Illinoian glacial till consists of a well graded mixture of clay, silt, and sand having pebbles, cobbles, and occasional boulders. The loess is an eolian (wind-blown) deposit of clay and silt which tends to have a relatively uniform particle size and varies in thickness from a trace in the southwest portion of the region to over 100 feet along the Missouri River. In some areas, loess and glacial till have been eroded, creating residual soils weathered from the underlying bedrock. The surficial soils throughout the area are underlain by the Pennsylvanian bedrock system which consists of undifferentiated formations of shale and limestone.

3.2 Surface Conditions

At the time of our exploration, the proposed area for the multipurpose building was a grassed lawn lot immediately west of the existing high school building. The proposed area for the new parking lot had trees present, and had been the site of residential structures until their recent demolition and removal.

3.3 Subsurface Conditions

Although we observed some variability, the subsurface materials we encountered within the depths of exploration generally comprised fill materials and sandy lean clay. General descriptions of the strata we encountered are presented below, while more detailed subsurface information is presented on the boring logs located in Appendix B. Please note that the indicated depths are relative to the site grade at the time of our exploration.

Stratum 1

We encountered sandy lean clay in all borings. In borings MP-1 and MP-2 the sandy lean clay was encountered beneath a thin layer of topsoil. In borings MP-3 and MP-4, we encountered the sandy lean clay beneath the topsoil and a thin layer of lean clay. In borings PH-1 through PH-3, topsoil and an 8-foot thick layer of fill was encountered above the sandy lean clay. In all borings, the sandy lean clay extended to the termination depths of 10 and 15 feet. This material was generally described as

dark brown and dark olive brown or gray and light gray. We measured Standard Penetration Test (SPT) N-values between 7 and 18 blows per foot (bpf), indicating the sandy lean clay is in a medium stiff to very stiff condition.

Stratum 2

We encountered lean clay fill materials in borings PH-1 through PH-2. This material was generally described as dark brown and light brown mottled with rust and moist. We measured SPT N-values between 6 and 20 bpf, indicating the fill is in a medium stiff to very stiff condition. The fill materials appear to have been placed in a controlled manner.

3.4 Groundwater Conditions

Our drill crew made water level observations during drilling and after completion of the borings to evaluate groundwater conditions. We did not encounter groundwater in any of our soil borings.

The groundwater conditions we observed during our exploration program should not be construed to represent an absolute or permanent condition. Uncertainty is involved with short-term water level observations in boreholes.

The free groundwater surface or groundwater table within unconfined aquifers is generally a subdued reflection of surface topography. Water generally flows downward from upland positions (recharge zones) to low lying areas or surface water bodies (discharge zones). As such, the groundwater level and the amount and level of any perched water on the site may be expected to fluctuate with variations in precipitation, site grading, drainage and adjacent land use. Long-term monitoring utilizing piezometers or observation wells is required to evaluate the potential range of groundwater conditions.

4. LABORATORY TESTING

Our engineering staff reviewed the field boring logs to outline the depth, thickness and extent of the soil strata. The samples taken from the borings were examined in our laboratory and visually classified in general accordance with ASTM D2488, “*Description and Identification of Soils (Visual-Manual Procedure)*.” We established a testing program to evaluate the engineering properties of the recovered samples. A GSI technician performed laboratory testing in general accordance with the following current ASTM test methods:

- Moisture Content (ASTM D2216, “*Laboratory Determination of Water (Moisture) Content of Soil and Rock*”)
- Unit Weight (ASTM D7263, “*Laboratory Determination of Density (Unit Weight) of Soil Specimens*”)
- Atterberg Limits (ASTM D4318, “*Liquid Limit, Plastic Limit, and Plasticity Index of Soils*”)
- Minus No. 200 Sieve Wash (ASTM D1140, “*Amount of Material in Soils Finer Than the No. 200 (75- μ m) Sieve*”)
- Unconfined Compressive Strength (ASTM D2166, “*Unconfined Compressive Strength of Cohesive Soil*”)

Laboratory test results are presented on the boring logs in Appendix B and tabulated in Appendix C.

Moisture content and unit weight tests were used to evaluate the existing moisture-density condition of the soils. The Atterberg limits and Minus No. 200 sieve tests were used to help classify the soils under the Unified Soils Classification System. The Atterberg limits were also used to evaluate the plasticity characteristics of the soils. Unconfined compression tests were used to define the stress-strain characteristics and related shear strength of the soils.

The following data summarize our laboratory test results. We used these data to develop the allowable bearing values, anticipated settlements, and other geotechnical design criteria for the project.

- Natural Moisture Content..... 3.5 to 27.1%
- Wet Density..... 120.6 lb/ft³
- Dry Density..... 94.6 lb/ft³
- Unconfined Compressive Strength 2.56 kips/ft²



- Liquid Limit..... 35 to 49
- Plastic Limit..... 15 to 19
- Plasticity Index 20 to 30
- Percent Passing the No. 200 Sieve53.3%
- Standard Penetration Test (SPT 'N' blows per foot) 7 to 20

Based on the results of this testing program, we reviewed and supplemented the field logs to arrive at the final logs as presented in Appendix B. The final logs represent our interpretation of the field logs and reflect the additional information obtained from the laboratory testing. Stratification boundaries indicated on the boring logs were based on observations made during drilling, an extrapolation of information obtained by evaluating samples from the borings, and comparisons of similar engineering characteristics. Locations of these boundaries are approximate and the transitions between soil types may be gradual rather than clearly defined.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 General Geotechnical Considerations

The soils we encountered in the test borings are generally capable of supporting the anticipated loads on shallow foundations. We did not encounter groundwater within the depth of expected excavation.

5.2 Earthwork

5.2.1 Site Preparation

We recommend existing utilities within the proposed building area be relocated to avoid passing beneath the new structure. Abandoned utility pipes that cannot be removed must be plugged with grout to reduce the potential for future collapse or moisture migration into the subgrade soils. Excavations resulting from utility removal must be replaced with engineered structural fill as outlined in Section 5.2.4.

Trees within the areas to be prepared for development must be removed. The root-balls and surrounding soils containing observable organic material must also be removed. We expect the root-balls will extend to substantially greater depths than the topsoil stripping depth. The root-ball excavations must be filled with an engineered structural fill that is placed, moisture conditioned and compacted in accordance with Section 5.2.4.

In preparing the site for construction, surface vegetation and topsoil containing a significant percentage of organic matter should be removed from the areas beneath structures and any other areas that are to be paved, cut or receive fill. The removal depth for this site is expected to be approximately 6 inches. However, the removal depth should be monitored during stripping and adjusted as required. This material should either be removed from the site or stockpiled for later use in landscaping of unpaved or non-structural areas.

After removal of the topsoil, the subgrade should be proof rolled with a loaded tandem axle dump truck or equivalent (loaded water truck, loaded concrete mixer or motor grader with a minimum weight of 20 tons). A proof-roll is considered acceptable if no ruts greater than one inch deep appear behind the loaded vehicle, and no pumping or weaving is observed as the wheels pass over the area. Any soft or unsuitable areas should be compacted or removed and replaced with stable fill material similar in composition to the surrounding soils. If necessary, clean materials such as

crushed concrete or crushed stone may be used to stabilize areas where wet soil or water is present. Geogrid or structural geotextile may be used in conjunction with crushed concrete or stone to provide additional stabilization.

Prior to fill placement, the top 9 inches of the ground surface in fill areas should be scarified, moisture conditioned and recompact in accordance with Section 5.2.4 to eliminate a plane of weakness along the contact surface.

5.2.2 General Structural Fill

General structural fill should be used for mass site grading, landscaping applications or as utility trench backfill outside of building areas. General structural fill may also be used to within 18 inches of the base of any granular cushion beneath floor slabs and to within 9 inches of the base of any vehicular pavements. In the former applications, low volume change materials are required immediately below the floor slabs or pavements (low volume change material is discussed in the following section).

General structural fill may comprise cohesive or granular material but should be free from organic matter or debris. Granular materials used as general structural fill should be well graded, have a maximum particle size of 1.5 inches, and meet KDOT freeze/thaw durability and sulfate soundness requirements.

If free of organic matter or debris, the on-site soils may be reused as general structural fill within the areas outlined above.

5.2.3 Low Volume Change Material (LVC)

Low volume change (LVC) material as specified for use below floor slabs and pavements must consist of material with a liquid limit (LL) less than 45 and a plasticity index (PI) between 15 and 25. LVC material could be a granular material but must have sufficient cohesion to form a compactable, uniform and stable subgrade. This typically translates to a material with greater than 15 percent fines (percent passing the No. 200 sieve). However, silty gravel (KDOT AB-3) or limestone screenings are also acceptable LVC materials. Granular materials with less than 15 percent fines may be used within confined areas such as within foundation stem walls.

We note that while portions of the on-site soils exhibit Atterberg limits outside the ranges presented above, these soils are generally sandy and as such, may be reused as LVC material if free of organic matter or debris.

5.2.4 Compaction of Engineered Structural Fills

Unless otherwise noted, fill materials should be placed in loose lifts not to exceed 9 inches and be compacted to a minimum of 95 percent of the maximum dry unit weight obtained from ASTM D698 (Standard Proctor). Moisture content at the time of compaction should be controlled to between optimum and 4 percent above optimum moisture content.

If possible, granular fill materials containing less than 15 percent fines should be compacted to a minimum of 95 percent of the maximum dry unit weight obtained from ASTM D698. Granular fill materials which do not produce a definable moisture-density curve when tested according to ASTM D698 should be compacted to a minimum of 75 percent relative density (ASTM D4253, "*Maximum Index Density and Unit Weight of Soils Using a Vibratory Table*" and ASTM D4254, "*Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density*"). Granular materials should be placed at a moisture content that will achieve the desired densities. Please note that relative density and standard Proctor tests measure different parameters and are not interchangeable.

In general, proper compaction of cohesive soils can be achieved with sheepsfoot or pneumatic-type compactors, while compaction of granular soils can be achieved with smooth-drum or smooth-plate vibratory compactors. Water flooding is not an acceptable compaction method for any soil type.

5.2.5 Utility Trench Backfill

As a minimum, utility trench backfill material should meet the requirements of general structural fill as defined in Section 5.2.2. Where utility trenches pass beneath structures, pavements or flatwork, the upper foot of utility backfill should meet the requirements of LVC material as defined in Section 5.2.3. Backfill soils in utility trenches must be placed in lifts of 6 inches or less in loose thickness and be compacted in accordance with Section 5.2.4.

Controlled low strength material (CLSM) or flowable fill may also be used for utility backfills. We recommend designing flowable fill with a compressive strength between 50 and 300 pounds per square inch (psi). CLSM with a maximum compressive strength less than 300 psi can be readily

excavated with a backhoe. The intent for the CLSM is to provide a backfill that can be placed in a single lift, without personnel entering the excavation and without the need for compaction equipment.

Where used beneath pavements, flatwork or structures, CLSM should be terminated one foot below the structure, floor slab or pavement subgrade elevation. To provide uniform support beneath pavements, flatwork and structures, the fill placed over the CLSM should be of similar composition as the surrounding bearing materials and be constructed as moisture-conditioned and compacted engineered structural fill in accordance with Section 5.2.4.

5.2.6 Foundation Backfill

As a minimum, backfill soils for formed foundations should meet the requirements of general structural fill as defined in Section 5.2.2. However, we recommend fill around foundations meet the requirements of LVC material as defined in Section 5.2.3. The use of LVC material to backfill foundations is intended to help reduce desiccation cracking adjacent to the structure, which can provide a pathway for water to infiltrate the foundation subgrade. If other cohesive materials are used to backfill foundations, the risk of differential movements caused by water infiltration into the foundation subgrade may be increased.

We also recommend the upper 18 inches of exterior foundation backfill have sufficient cohesion to direct surface water away from the structure. Granular materials such as sand and gravel are not suitable for use as exterior foundation backfill in the surficial 18 inches.

Backfill soils around formed foundations must be placed in lifts of 6 inches or less in loose thickness and be moisture conditioned and compacted in accordance with Section 5.2.4. Care should be exercised during compaction to avoid applying excessive stress to the foundation surfaces. Where both sides of a foundation wall are backfilled, the fill should be placed simultaneously in uniform lifts on both sides of the wall to reduce unbalanced lateral loads.

5.2.7 Correction of Unsuitable Foundation Soils

If soft, loose, or otherwise unsuitable soils are encountered at the base of any foundations, an over-excavation and replacement/recompaction procedure will be required. The unsuitable soils beneath the foundations should be removed to the required depth, with the excavation extending laterally 9 inches in all directions for each vertical foot of over-excavation. Structural fill for the over-excavated

areas should be of similar composition as the surrounding materials or meet the requirements of LVC material as defined in Section 5.2.3. Backfill material should be compacted in accordance with Section 5.2.4. CLSM, as defined in Section 5.2.5 may also be used to backfill over-excavated areas.

5.2.8 Excavation Slopes

Vertical cuts and excavations may stand for short periods of time, but should not be considered stable in any case. All excavations should be sloped back, shored, or shielded for the protection of workers. As a minimum, trenching and excavation activities should conform to federal and local regulations.

The clay soils we encountered in the test borings generally classify as a type “B” soil according to OSHA's Construction Standards for Excavations. In general, the maximum allowable slope for shallow excavations of less than 20 feet in a type “B” soil is 1.0H:1V, although other provisions and restrictions may apply. If different soil types are encountered, the maximum allowable slope may be different.

The Contractor is responsible for designing any excavation slopes or temporary shoring. The Contractor must also be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in federal, state, or local safety regulations, such as OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations.

The information presented in this section is solely for our client's reference. **GSI assumes no responsibility for site safety or the implementation of proper excavation techniques.**

5.3 Foundations

Based on the subsurface conditions revealed by the boring and testing program, this site appears suitable for use of a shallow foundation system. The selection of an allowable soil bearing pressure for shallow foundation elements must fulfill two requirements. First, the foundation load must be sufficiently less than the ultimate soil bearing capacity to ensure stability. Second, the total and differential settlements must not exceed amounts which will produce adverse behavior of the superstructure.

In order to meet the previous criteria, we have explored both the bearing capacity and the load settlement characteristics of the site soils assuming typical wall loads of 8 kips per lineal foot. The bearing capacity is based on a factor of safety of three against the full dead load plus normal live load. In our analysis, we used a maximum allowable total settlement of one inch and a maximum allowable differential settlement of $\frac{3}{4}$ of an inch within 50 lineal feet. These limits are generally considered acceptable for most structures.

A net allowable soil bearing pressure of 2,500 pounds per square foot (psf) may be used to size continuous strip and spread foundation elements bearing on native clay materials. The allowable bearing pressure is expressed in terms of the net pressure transferred to the soil. The net allowable bearing pressure is defined as the total structural dead load including the weight of the foundation elements, less the weight of the soil excavated for the foundation elements. This value may be increased by one-third for transient loading conditions such as wind or seismic forces.

This site appears to be suitable for the use of trenched “grade beam” type footings. Trenched footings utilize the excavation side walls as a form. Because separate forms do not need to be installed, this type of footing can be constructed more quickly and eliminate the need to backfill the foundation. Stresses applied to the soil by the foundation are also distributed more evenly.

All exterior and any interior foundation elements exposed to freezing conditions should be constructed at least 3.5 feet below the surrounding exterior grade to help reduce the effects of frost and seasonal moisture changes. Interior footings, which will be protected from the effects of frost, may be founded 1.5 feet below finished floor elevation.

We recommend that concrete be placed as soon as practical after footing excavation, with as little disturbance to the bearing soils as possible. Footing excavations should be free of loose soil or debris. Loose or disturbed soil must be removed or compacted prior to foundation construction. Water that collects in the excavations should be promptly removed to prevent softening of the foundation supporting soils prior to concrete placement. In addition, we recommend all excavations be observed by our geotechnical personnel prior to placement of concrete for the possible presence of unsuitable bearing soils. If unsuitable bearing soils are encountered during construction, these areas should be corrected in accordance with Section 5.2.7.



If shallow foundations are designed and constructed in accordance with the recommendations presented, total settlements are not expected to exceed one inch with differential settlements less than $\frac{3}{4}$ of an inch within 50 lineal feet.

5.4 Floor Slabs

The clay-containing soils we encountered at this site, though moderately plastic in some areas, are generally sandy and exhibit a low swell potential. However, the dry condition of these soils presents a risk of causing slab movement. Most slabs-on-grade will experience some amount of vertical movement, which the Owner must be willing to accept. Recommendations to help reduce the risk of movement of a slab supported on clay soils are presented below.

To provide uniform support for floor slabs and reduce the potential for subgrade volume change, we recommend all floor slabs bear on a minimum of 18 inches of LVC material as defined in Section 5.2.3. The placement and compaction of the LVC material should conform to the recommendations in Section 5.2.5 of this report. Depending on final site grades, this LVC layer could comprise on-site soils that have been moisture-conditioned and recompacted in place. We recommend the LVC layer be placed in two, 9-inch lifts.

By constructing an 18-inch layer of low plasticity, low volume change material immediately beneath the floor slab and closely controlling the moisture and density of the scarified soil and new fill materials, it is our opinion that the potential for detrimental floor slab movement will be reduced to less than $\frac{3}{4}$ of an inch. A greater thickness of low volume change material or moisture conditioned native soils beneath the floor slab may further reduce potential slab movement. If slab movements up to $\frac{3}{4}$ of an inch are not acceptable, please contact GSI for further floor slab recommendations.

We recommend a 2- to 4-inch thick sand cushion be placed beneath the floor slab in addition to the low plasticity, low volume change material. This layer should be free-draining, well-graded and compacted by vibration prior to placing the floor slab. The sand cushion should be moist, but not saturated, at the time of concrete placement.

We also recommend the moisture content of upper 9 inches of the subgrade be checked prior to placement of a sand base, reinforcing steel or concrete floor slab. If the moisture content of the

subgrade is below optimum, we recommend the subgrade be scarified, moisture conditioned and recompacted according to Section 5.2.4.

In many construction projects, the moisture content of the floor slab subgrade is tested during grading of the site and then remains exposed until floor slab placement occurs several weeks later. In this situation, even LVC material is subject to some swell movement if not properly moisture conditioned prior to slab placement. Periodic applications of water will help maintain the proper moisture content of subgrade soils. The risk of differential movements can be reduced by creating and properly preparing a LVC zone beneath the slab as well as ensuring proper drainage is maintained around the structure at all times.

We recommend the floor covering manufacturer be consulted regarding the use of a vapor retarder beneath floor slabs. If a vapor retarder is recommended by the floor covering manufacturer, it should conform to the manufacturer's specifications to maintain the product warranty.

5.5 Pavement Recommendations

The asphalt and Portland cement concrete pavement recommendations provided below are separated into a regular duty and a heavy duty section. To perform properly, the pavement sections require that the subgrade be prepared in accordance with the recommendations in Section 5.5.1.

5.5.1 Pavement Subgrade Preparation

Pavement performance is directly affected by the degree of compaction, uniformity, and stability of the subgrade. The stability and quality of the pavement subgrade is particularly important where high traffic volume and heavy axle loads are anticipated.

If pavements will be placed on native soils, we recommend the top 9 inches of the subgrade be moisture conditioned and recompacted as outlined in Section 5.2.4 of this report. If off-site soils are used to raise the site grade, we recommend these materials meet the requirements of LVC material as defined in Section 5.2.3.

Providing LVC material or moisture-conditioning the native soils beneath pedestrian pavements will enhance pavement performance but is an economic consideration between initial construction cost and future potential pavement maintenance costs. If pedestrian pavements are constructed on



unimproved native soils, the Owner should expect some movement to occur as the result of seasonal moisture fluctuations.

The top 9 inches of pavement subgrade should be compacted to a minimum of 95 percent of the maximum dry unit weight determined by ASTM D698. The moisture content should also be controlled to between optimum and 4 percent above the optimum moisture content.

To detect any localized areas of instability, the final subgrade should be proof rolled with a loaded tandem axle dump truck or equivalent (loaded water truck, loaded concrete mixer or motor grader with a minimum weight of 20 tons) immediately prior to placement of the concrete or asphalt. Unstable areas should be removed and replaced or reworked to provide a more uniform subgrade. If necessary, clean materials such as crushed concrete or crushed stone may be used to stabilize areas where wet soil or water is present. Geogrid or structural geotextile may be used in conjunction with crushed concrete or stone to provide additional stabilization.

We also recommend the moisture content of the subgrade be checked prior to paving. If the moisture content is below optimum, we recommend the subgrade be scarified, moisture conditioned and recompacted according to Section 5.2.4.

5.5.2 Recommended Design Sections

The pavement sections for this project are based on our experience with similar pavements and a design life of 15 to 20 years. The regular duty pavement sections are intended for passenger car and light truck traffic and parking areas. The heavy duty pavement sections are intended for areas that will experience high traffic volumes or heavy axle loads such as main access drives or delivery truck routes. Portland cement concrete pavements are recommended for areas with frequent start-stop or turning traffic such as entrance and exit aprons or the parking stalls closest to buildings, as well as areas that support stationary loads such as dumpsters.

Our recommendations for full-depth asphalt and Portland cement concrete pavement sections are presented in the following tables.

Table 5.5.2-1: Full-Depth ACC Pavement Design Recommendations

	<i>Regular Duty Section</i>	<i>Heavy Duty Section</i>
<i>KDOT BM-2 Wear Course (in.)</i>	2.0	2.0
<i>KDOT BM-2 Base Course (in.)</i>	3.5	5.5
<i>LVC Subgrade</i>	9.0 (minimum)	9.0 (minimum)

**LVC subgrade placed and compacted in accordance with Section 5.5.1.*

Table 5.5.2-2: PCC Pavement Design Recommendations

	<i>Thickness (Inches)</i>		
	<i>Sidewalks & Pedestrian Areas</i>	<i>Regular Duty Section</i>	<i>Heavy Duty Section</i>
<i>KDOT MA-2 Air Entrained Portland Cement Concrete (in.)</i>	4.0	5.0	6.0
<i>LVC Subgrade</i>	See Section 5.5.1	9.0 (minimum)	9.0 (minimum)

**LVC subgrade placed and compacted in accordance with Section 5.5.1.*

5.5.3 Asphaltic Cement Concrete Pavement Construction

Asphalt should be placed at an ambient temperature above 40 degrees Fahrenheit. Asphalt temperature at the time of compaction should be between 265 and 330 degrees Fahrenheit. We recommend the initial asphalt lift placed directly on the subgrade should be compacted to a minimum of 94 percent of the Marshall density with subsequent asphalt lifts compacted to a minimum of 96 percent of the Marshall density. Please note that recommendations regarding compaction temperature and percentage for a specific pavement design should supersede these recommendations.

All asphaltic concrete mix designs should be submitted to GSI and reviewed to determine if the designs are consistent with the recommendations given in this report. We also recommend a GSI representative be present during paving operations to help ensure adherence to project pavement specifications.

5.5.4 General Pavement Considerations

Pavement service life can be significantly reduced if the pavement is constructed on a poor subgrade, if poor surface or subsurface drainage is present, or if the pavement is not maintained

properly. We emphasize the importance of preparing the pavement subgrade in accordance with the procedures listed in the previous sections of this report.

Drainage of surface and subsurface water is also a critical component of pavement performance. Wetting of the subgrade soils or base course will cause loss of support strength resulting in premature pavement distress. Surface drainage should be designed to remove all water from paved areas. All curbs, including those surrounding pavement islands, should be backfilled as soon as possible after construction of the pavement. Backfill should be compacted and sloped to prevent water from ponding and infiltrating under the pavement. Regular active maintenance of pavements, which includes filling of cracks and joints, is required to minimize water infiltration and lengthen pavement life.

5.6 Surface Drainage and Landscaping

The success of the shallow foundation system, slab-on-grade floor system, and pavement section is contingent upon keeping the moisture content of subgrade soils as constant as possible and not allowing surface drainage to have a path to the subsurface soils. Positive surface drainage away from structures must be maintained throughout the design life of the structures. Landscaped areas should be designed and constructed such that irrigation and other surface water will be collected and carried away from foundation elements. Pavements should be sloped or crowned to direct surface water to storm sewer systems or detention/retention ponds.

During construction, temporary grades should be established to prevent runoff from entering excavations or footing trenches. Backfill should be placed as soon as concrete structural strength requirements are met and should be graded to drain away from the building.

The final grade of the foundation backfill and any overlying pavements should have a positive slope away from foundation walls on all sides. We typically recommend a minimum slope of one inch per foot for the first 5 to 10 feet for uncovered surfaces. However, the slope may be decreased if the ground surface adjacent to foundations is covered with concrete slabs or asphalt pavements. For other areas of the site, we recommend a minimum slope of two percent. Pavements and exterior slabs that abut structures should be carefully sealed against moisture intrusion at the joint. All downspouts and faucets should discharge onto splash blocks that extend at least five feet from the

building line or be tied into the storm drain system. Splash blocks should slope away from the foundation walls.

The placement of vegetation and plantings next to the foundation should be minimized. Where landscaping is required, we recommend considering plants and vegetation that require minimal irrigation. Irrigation within ten feet of the foundation should be carefully controlled and minimized.

5.7 Construction Considerations

If construction of the project is to be performed during periods of freezing temperatures, steps should be taken to prevent the soils under floor slabs, footings, or pavements from freezing. In no case should the fill materials, floor slabs, foundations, pavements, or other exterior flat work be placed on frozen or partially frozen materials. Frozen materials should be removed and replaced with a suitable material as described in earlier sections of this report.

Construction performed during periods of high precipitation may result in saturated unstable soils, and caving or sloughing of excavations. Control of soil moisture will be necessary for successful soil compaction, and to maintain soil bearing capacity.

5.8 Construction Observation and Quality Assurance

We recommend that GSI review those portions of the plans and specifications that pertain to foundations and earthwork to evaluate consistency with our findings and recommendations. GSI will provide up to 2 hours of engineering support services at no charge to review project documents for adherence to our recommendations.

Site grading, including proof-rolling, replacement or recompaction of material, and placement of fill and backfill, should be observed by a quality assurance technician from GSI under the direction of a registered professional engineer. The technician should perform density tests and make any other observations necessary to assure that the requirements of the specifications are being achieved.

It is the opinion of GSI that construction observation by the geotechnical engineer of record or his designated representative is necessary to complete the design process. Field observation services are viewed as essential and a continuation of the design process. Unless these services are provided by GSI, the geotechnical engineer will not be responsible for improper use of our



recommendations or failure by others to recognize conditions which may be detrimental to the successful completion of the project.

GSI will be available to make field observations and provide consultation services as may be necessary. A written proposal outlining the cost of construction testing services such as soil, concrete, steel, and pavement quality assurance can be provided upon request.



6. CLOSING REMARKS AND LIMITATIONS

This report is presented in broad terms to provide an assessment of the subsurface conditions and their potential effect on the adequate design and economical construction of the proposed structure and pavement. The analyses, conclusions, and recommendations contained in this report are based on the site conditions existing at the time of the exploration, the project layout described herein, and the assumption that the information obtained from our seven borings is representative of subsurface conditions throughout the site.

Any changes in the design or location of the proposed structure should be assumed to invalidate the conclusions and recommendations given in this report until we have had the opportunity to review the changes and, if necessary, modify our conclusions and recommendations accordingly. If subsurface conditions different from those encountered in the explorations are observed during construction or appear to be present beneath excavations, GSI should be advised at once so that the conditions can be reviewed and recommendations reconsidered where necessary.

If there is a substantial lapse in time between the submission of this report and the start of construction, or if site conditions or the project layout have significantly changed (due to further development of grading plans, natural causes, or construction operations at or adjacent to the site), we recommend that this report be reviewed to determine the applicability of our previous conclusions and recommendations.

Our geotechnical exploration and subsequent recommendations address only the design and construction considerations contained in this report. We make no warranty for the contents of this report, neither expressed nor implied, except that our professional services were performed in accordance with engineering principles and practices generally accepted at this time and location.

The scope of services for this exploration did not include a wetlands evaluation, an environmental assessment, or an investigation for the presence of hazardous or toxic materials in the soil, surface water, groundwater, or air within or adjacent to this site. If contamination is suspected or is a concern, we recommend the scope of this study be expanded to include an environmental assessment.

This report was prepared by the firm of GSI Engineering, LLC (GSI) under the supervision of a professional engineer registered in the State of Kansas. Report preparation was in accordance with


generally accepted geotechnical engineering practices for the exclusive use of our client for evaluating the design of the project as it relates to the geotechnical aspects discussed herein. Recommendations are based on the applicable standards of the profession at the time of this report within this geographic area. GSI Engineering, LLC will not be responsible for misrepresentation of this report resulting from partial reproduction or paraphrasing of its contents.

We appreciate the opportunity to be of service on this project. Please contact us if we can provide further information regarding the contents of this report or the scope and cost of additional services.

Respectfully submitted,
GSI Engineering, LLC



Jose L. Vitteri, P.E.
Project Engineer



Thomas C. Kettler, Jr., P.E.
Senior Engineer



JLV/TCK

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Kansas.

Sections covered by this seal:

Sections 1 through 6 and all pages included as appendices within this bound document.

G:\JOBS\Wichita\177\1773\1773023\High School Complex\Geo-Rpt High School Complex (1773023B).docx

APPENDIX A

General Vicinity Map
Boring Location Plan

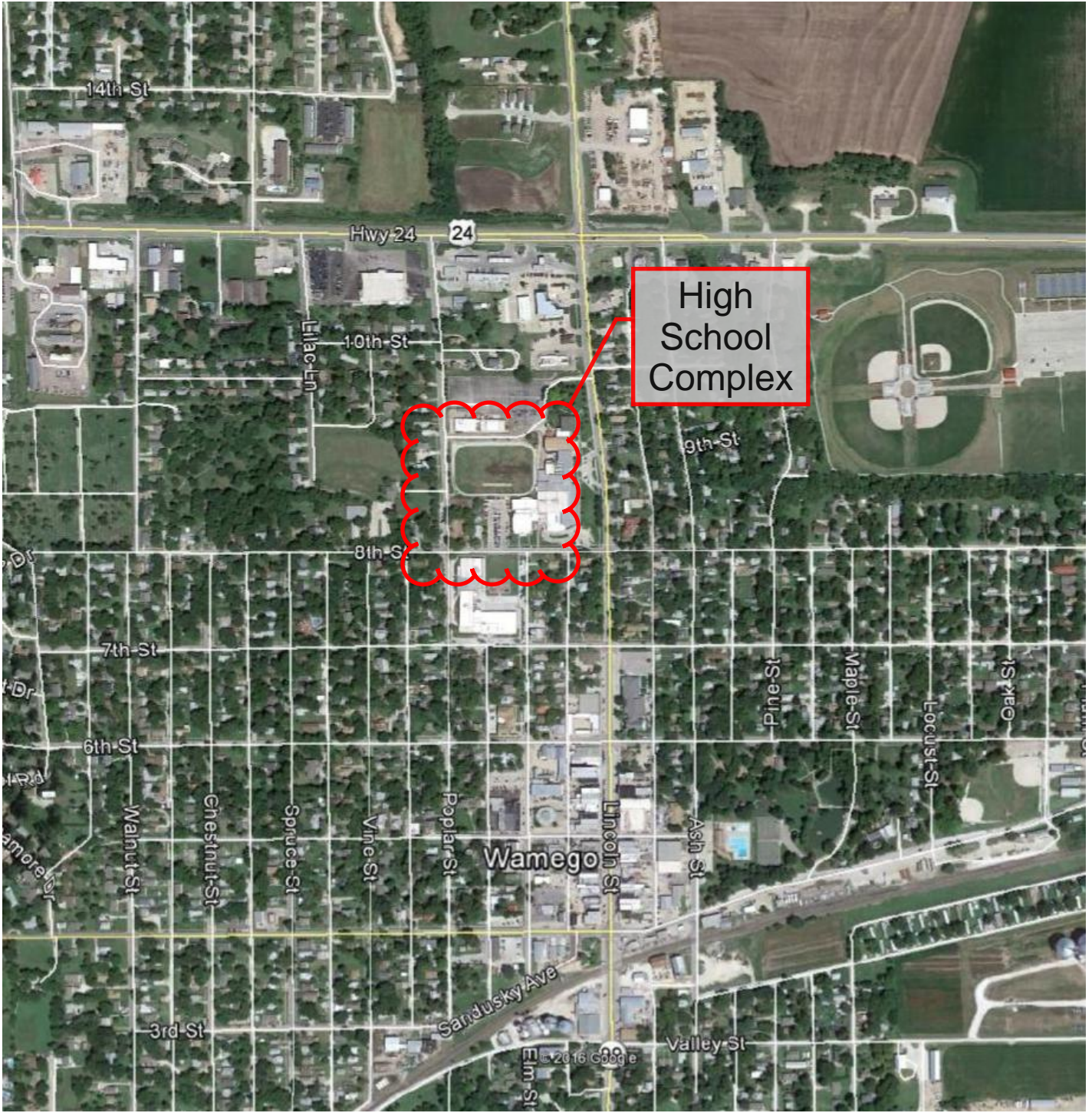
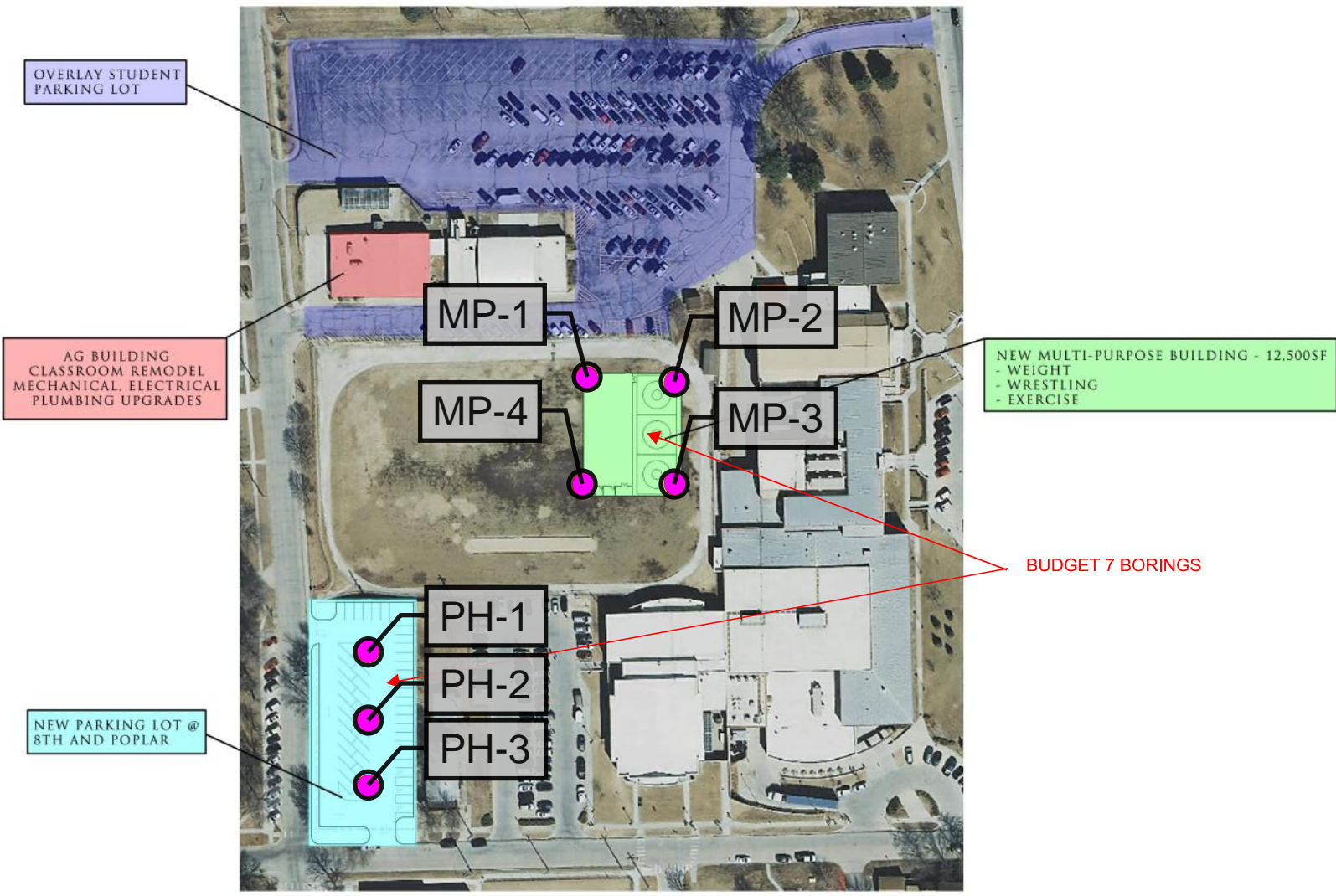


FIG. #:	1	PROJ #:	1773023B
DATE:	3/08/17	SCALE:	NTS
DRAWN BY:	JLV	PROJECT MANAGER:	MNT



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**GENERAL VICINITY MAP
 USD 320 HIGH SCHOOL COMPLEX
 WAMEGO, KANSAS**



SITE PLAN - HIGH SCHOOL COMPLEX

APPENDIX B

Boring Logs

Key to Symbols

Legend & Nomenclature

Unified Soil Classification System (USCS)

BORING LOG No. MP-1

BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER
MP-1	See Boring Location Plan			J. Tinnell	R. Hopkins
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	AFTER DRILLING	Grass	Mobile B-61
N.E.	N.E.	Boring Plugged After Drilling		3.25-inch Inside Diameter Hollow Stem Augers	15.0 ft.

DEP. FT.	SAMPLE DATA			SOIL DESCRIPTION		LABORATORY DATA			ELEV. FT.
	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	COLOR, CONSISTENCY, MOISTURE	USCS CLASS.	MC %	Dry Dens. pcf	q _u ksf	
				GEOLOGIC DESCRIPTION & OTHER REMARKS					
				✓✓✓✓✓	6" TOPSOIL				
	S-1	10			SANDY LEAN CLAY- dark brown, moist, medium stiff, roots and organics		16.3		
	S-2	7			- dark olive brown, stiff, else as above		14.8		
5	S-3	16			- dark gray, very stiff, else as above		25.0		
	S-4	11			- light gray, stiff, rust deposits, else as above	CL	22.8		
10									
	S-5	7			- light brown, medium stiff, rust, else as above		20.7		
15					Bottom of Boring @ 15'				
20									
25									
30									
35									
40									



4503 East 47th Street South
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 316-554-0725

PROJECT: Wamego High School Complex
LOCATION: Wamego, Kansas
JOB NO.: 1773023B
DATE: February 9, 2017

BORING LOG No. MP-2

BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER
MP-2	See Boring Location Plan			J. Tinnell	R. Hopkins
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	AFTER DRILLING	Grass	Mobile B-61
N.E.	N.E.	Boring Plugged After Drilling		3.25-inch Inside Diameter Hollow Stem Augers	15.0 ft.

DEP. FT.	SAMPLE DATA			SOIL DESCRIPTION		LABORATORY DATA			ELEV. FT.
	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	COLOR, CONSISTENCY, MOISTURE	USCS CLASS.	MC %	Dry Dens. pcf	q _u ksf	
				GEOLOGIC DESCRIPTION & OTHER REMARKS					
				✓✓✓✓✓	6" TOPSOIL				
	S-1	17		SANDY LEAN CLAY- dark brown, dry, very stiff, roots and organics LL=49; PL=19; PI=30 % Pass #200: 53.3 - dark olive brown, slightly moist, stiff, trace gravel - very moist, else as above - gray, moist, rust deposits, else as above - brown, heavy rust deposits, else as above	0.5'	3.5			
	S-2	11				14.4			
5	S-3	8				27.1	94.9	2.56	
	S-4	9				21.0			
10	S-5	7				22.0			
15					Bottom of Boring @ 15'	15.0'			
20									
25									
30									
35									
40									



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 Wichita, KS 67210
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PROJECT: Wamego High School Complex
LOCATION: Wamego, Kansas
JOB NO.: 1773023B
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BORING LOG No. MP-3

BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER
MP-3	See Boring Location Plan			J. Tinnell	R. Hopkins
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	AFTER DRILLING	Grass	Mobile B-61
N.E.	N.E.	Boring Plugged After Drilling		3.25-inch Inside Diameter Hollow Stem Augers	15.0 ft.

DEP. FT.	SAMPLE DATA			SOIL DESCRIPTION		LABORATORY DATA			ELEV. FT.	
	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	COLOR, CONSISTENCY, MOISTURE		USCS CLASS.	MC %	Dry Dens. pcf		q _u ksf
				GEOLOGIC DESCRIPTION & OTHER REMARKS						
				✓✓✓✓✓	6" TOPSOIL					
	S-1	16		/ / / / /	LEAN CLAY- dark brown, slightly moist, very stiff to stiff, roots and organics	CL	16.9			
	S-2	12		. . . . .	SANDY LEAN CLAY- dark yellowish brown, slightly moist, stiff, carbon deposits		9.6		
5	S-3	8		. . . . .	- dark brown, rust deposits, else as above		14.2		
10	S-4	14		. . . . .	- gray, heavy rust deposits, else as above	CL	10.5		
15	S-5	18		- olive brown, very stiff, heavy rust deposits, else as above		11.9			
					Bottom of Boring @ 15'					
20										
25										
30										
35										
40										



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PROJECT: Wamego High School Complex
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DATE: February 9, 2017

BORING LOG No. MP-4

BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER
MP-4	See Boring Location Plan			J. Tinnell	R. Hopkins
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	AFTER DRILLING	Grass	Mobile B-61
N.E.	N.E.	Boring Plugged After Drilling		3.25-inch Inside Diameter Hollow Stem Augers	15.0 ft.

DEP. FT.	SAMPLE DATA			SOIL DESCRIPTION		LABORATORY DATA			ELEV. FT.	
	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	COLOR, CONSISTENCY, MOISTURE		USCS CLASS.	MC %	Dry Dens. pcf		q _u ksf
				GEOLOGIC DESCRIPTION & OTHER REMARKS						
				✓✓✓✓✓	6" TOPSOIL	0.5'				
	S-1	12			LEAN CLAY- olive brown, slightly moist, stiff, roots and organics LL=35; PL=16; PI=19	0.5'	CL	13.2		
	S-2	16			SANDY LEAN CLAY- dark brown, moist, very stiff, rust deposits	2.5'				
5	S-3	7			- medium stiff, else as above			17.2		
	S-4	16			- dark gray, moist, very stiff, carbon deposits		CL	20.2		
10										
	S-5	10			- light gray, rust deposits, else as above			13.8		
15					Bottom of Boring @ 15'	15.0'				
20										
25										
30										
35										
40										



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BORING LOG No. PH-1

BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER
PH-1	See Boring Location Plan			J. Tinnell	R. Hopkins
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	AFTER DRILLING	Grass	Mobile B-61
N.E.	N.E.	Boring Plugged After Drilling		3.25-inch Inside Diameter Hollow Stem Augers	TOTAL DEPTH 10.0 ft.

DEP. FT.	SAMPLE DATA			SOIL DESCRIPTION		LABORATORY DATA			ELEV. FT.
	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	COLOR, CONSISTENCY, MOISTURE	USCS CLASS.	MC %	Dry Dens. pcf	q _u ksf	
				GEOLOGIC DESCRIPTION & OTHER REMARKS					
				✓✓✓✓✓	6" TOPSOIL				
	S-1	6		X	FILL (LEAN CLAY)- dark brown mottled with light brown and rust, moist, medium stiff		25.9		
	S-2	8		X	- as above		26.5		
5	S-3	20		X	- very stiff, else as above	CL	18.3		
	S-4	12		X	SANDY LEAN CLAY- yellowish brown, slightly moist, stiff, rust deposits	CL	12.0		
10					Bottom of Boring @ 10'				
15									
20									
25									
30									
35									
40									



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PROJECT: Wamego High School Complex
LOCATION: Wamego, Kansas
JOB NO.: 1773023B
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BORING LOG No. PH-2

BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER
PH-2	See Boring Location Plan			J. Tinnell	R. Hopkins
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	AFTER DRILLING	Grass	Mobile B-61
N.E.	N.E.	Boring Plugged After Drilling		3.25-inch Inside Diameter Hollow Stem Augers	10.0 ft.

DEP. FT.	SAMPLE DATA			SOIL DESCRIPTION		LABORATORY DATA			ELEV. FT.
	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	COLOR, CONSISTENCY, MOISTURE	USCS CLASS.	MC %	Dry Dens. pcf	q _u ksf	
				GEOLOGIC DESCRIPTION & OTHER REMARKS					
				6" TOPSOIL					
	S-1	8		FILL (SANDY LEAN CLAY)- dark brown mottled with rust, moist, stiff	0.5'	20.4			
	S-2	10		LL=43; PL=15; PI=28 - light brown mottled with rust, else as above		21.3			
5	S-3	12		- as above		22.5			
	S-4	12		SANDY LEAN CLAY- yellowish brown, slightly moist, stiff, rust deposits	8.5'	14.0			
10				Bottom of Boring @ 10'	10.0'				
15									
20									
25									
30									
35									
40									



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PROJECT: Wamego High School Complex
LOCATION: Wamego, Kansas
JOB NO.: 1773023B
DATE: February 9, 2017

BORING LOG No. PH-3

BORING NO.	LOCATION OF BORING	ELEVATION	DATUM	DRILLER	LOGGER
PH-3	See Boring Location Plan			J. Tinnell	R. Hopkins
WATER LEVEL OBSERVATIONS			TYPE OF SURFACE		DRILL RIG
WHILE DRILLING	END OF DRILLING	24 HOURS AFTER DRILLING	AFTER DRILLING	Grass	Mobile B-61
N.E.	N.E.	Boring Plugged After Drilling		3.25-inch Inside Diameter Hollow Stem Augers	10.0 ft.

DEP. FT.	SAMPLE DATA			SOIL DESCRIPTION		LABORATORY DATA			ELEV. FT.	
	SAMPLE NO. & TYPE	"N" BLOWS (FT)	% REC.	COLOR, CONSISTENCY, MOISTURE		USCS CLASS.	MC %	Dry Dens. pcf		q _u ksf
				GEOLOGIC DESCRIPTION & OTHER REMARKS						
				✓✓✓✓✓	6" TOPSOIL					
	S-1	7			FILL (LEAN CLAY)- dark and light brown, moist, medium stiff		23.5			
	S-2	14			- stiff, else as above		20.3			
5	S-3	15			- as above	CL	22.0			
	S-4	13			SANDY LEAN CLAY- yellowish brown, moist, stiff, rust deposits	CL	13.9			
10					Bottom of Boring @ 10'					
15										
20										
25										
30										
35										
40										



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PROJECT: Wamego High School Complex
LOCATION: Wamego, Kansas
JOB NO.: 1773023B
DATE: February 9, 2017

KEY TO SYMBOLS

Symbol Description

Strata symbols



Topsoil



Lean Clay w/ Sand or Sandy
Lean Clay



Low plasticity
clay



Fill

Notes:

1. The exploratory borings were drilled on February 9, 2017 using 3.25-inch inside diameter hollow stem augers.
2. These logs are subject to the limitations, conclusions, and recommendations in this report.
3. Results of tests conducted on samples recovered are reported on the logs.

Boring Log Legend and Nomenclature

Items shown on boring logs refer to the following:

1. **Depth** - Depth below ground surface or drilling platform
2. **Sample** -Types designated by letter:
 - A - Disturbed sample, obtained from auger cuttings or wash water.
 - S - Split barrel sample, obtained by driving a 2-inch split-barrel sampler unless otherwise noted.
 - C - California liner sample, obtained using a thick-walled liner sampler containing 2-inch-diameter liner tubes.
 - U - Undisturbed sample, obtained using a thin-walled tube, 3-inch-diameter, or as noted, and open sampling head.

Recovery - Recovery is expressed as a percentage of the length recovered to the total length pushed, driven or cored.

Resistance - Resistance is designated as follows:

 - P - Sample pushed in one continuous movement by hydraulic rig action.
 - 12 - The Standard Penetration Resistance is the number of blows for the last 12 inches of penetration of split spoon sampler, driven by a 140-pound hammer falling 30 inches.
 - 50/4" - Number of blows to drive sampler distance shown.
3. **Soil Description** - Description of material according to the Unified Soil Classification: word description giving soil constituents, consistency or density, and other appropriate classification characteristics. Geologic name or type of deposit and other pertinent information, where appropriate, is shown under Geologic Description or other Remarks. A solid line indicates the approximate location of stratigraphic change.
4. **Lab Data** – Laboratory test data.
5. **Legend**

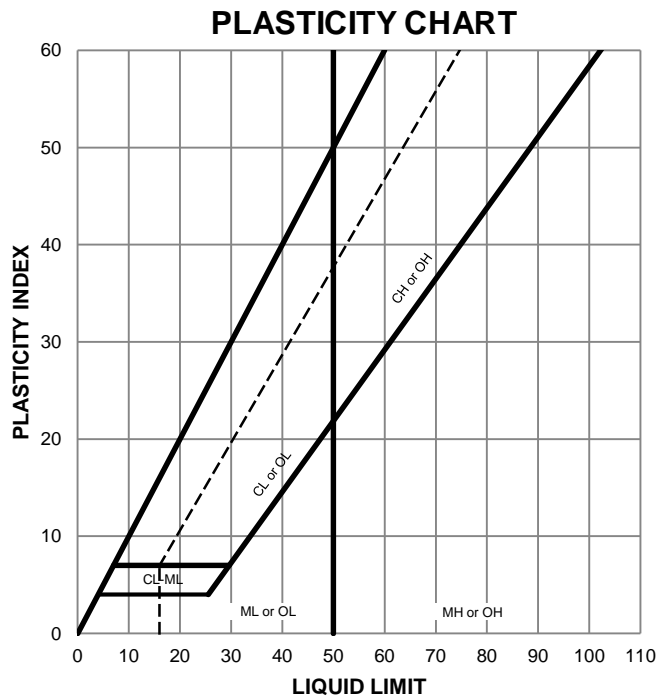
A.D. — After drilling	N.A. — Not Applicable
A.T.D. — At time of drilling	N.D. — Not detectable due to
C.F.A. — Continuous flight auger	drilling method
D.W.L. — Drill water loss	N.E. — None encountered
D.W.R. — Drill water return	N.R. — Not recorded
E.D. — End of drilling	R.Q.D. — Rock quality designation
H.B. — Hole backfilled	R.W.B. — Rotary wash boring
6. **Limitations** - The lines between materials shown on the boring logs represent approximate boundaries between material types and the changes may be gradual. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water levels may occur with time. The boring logs in this report are subject to the limitations, explanations and conclusions of this report.

UNIFIED SOIL CLASSIFICATION SYSTEM

GROUP NAME	GROUP SYMBOL	SOIL DESCRIPTION	COMMENTS
Peat	Pt	Highly Organic Soils	50% or More Is Smaller than No. 200 Sieve
Fat Clay	CH	Clay - Liquid Limit \Rightarrow 50*	
Elastic Silt	MH	Silt - Liquid Limit \Rightarrow 50*	
Lean Clay	CL	Clay - Liquid Limit $<$ 50*	
Silt	ML	Silt - Liquid Limit $<$ 50*	
Silty Clay	CL-ML	Silty Clay*	
Clayey Sand	SC	Sands with 12 to 50% Smaller than No. 200 Sieve	More than 50% Is Larger than No. 200 Sieve and % Sand $>$ % Gravel
Silty Sand	SM	Sands with 5 to 12% Smaller than No. 200 Sieve	
Poorly-Graded Sand with Clay	SP-SC	Sands with Less than 5% Smaller than No. 200 Sieve	
Poorly-Graded Sand with Silt	SP-SM		
Well-Graded Sand with Clay**	SW-SC		
Well-Graded Sand with Silt**	SW-SM		
Poorly-Graded Sand	SP	Gravels with 12 to 50% Smaller than No. 200 Sieve	
Well-Graded Sand**	SW		
Clayey Gravel	GC	Gravels with 5 to 12% Smaller than No. 200 Sieve	More than 50% Is Larger than No. 200 Sieve and % Gravel $>$ % Sand
Silty Gravel	GM		
Poorly-Graded Gravel with Clay	GP-GC		
Poorly-Graded Gravel with Silt	GP-GM		
Well-Graded Gravel with Clay**	GW-GC		
Well-Graded Gravel with Silt**	GW-GP		
Poorly-Graded Gravel	GP	Gravels with Less than 5% Smaller than No. 200 Sieve	
Well-Graded Gravel**	GW		

*See Plasticity Chart for definition of silts and clays. If organic, use OL or OH.

**See definition of well-graded



LEGEND OF TERMS

MOISTURE CONDITIONS
Dry, Slightly Moist, Moist, Very Moist, Wet (Saturated)

SOIL CONSISTENCY

Fine-Grained Soils

Description	SPT (N)	UCS (q_u , tsf)
Very Soft	0-2	0-0.25
Soft	2-4	0.25-0.50
Medium Stiff	4-8	0.50-1.0
Stiff	8-16	1.0-2.0
Very Stiff	16-32	2.0-4.0
Hard	>32	>4.0

Coarse-Grained Soils

Description	SPT (N)
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	>50

CLASSIFICATION OF SANDS & GRAVELS

Boulders	Cobbles	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	Fines (Silt or Clay)
10"	3"	3/4"	#4	#10	#40	#200	

Well-Graded Sands (SW): $C_u \geq 6$ and $1 \leq C_c \leq 3$

Well-Graded Gravels (GW): $C_u \geq 4$ and $1 \leq C_c \leq 3$



APPENDIX C

Field & Laboratory Test Results

Boring No.	Sample No.	Sample Depth (ft)	Sample Type	Sample Diameter (in)	Sample Length (in)	Moisture Content (%)	Wet Unit Weight (lb/ft ³)	Dry Unit Weight (lb/ft ³)	Unconfined Compressive Strength (kips/ft ²)	Atterberg Limits			Percent Passing No. 200 Sieve	Blow Counts SPT 'N' (blows/ft)	USCS Soil Classification	
										Liquid Limit	Plastic Limit	Plasticity Index				
MP-1	S-1	0.5-2.0	Split Spoon			16.3								10	Sandy CL	
	S-2	2.5-4.0	Split Spoon			14.8								7	Sandy CL	
	S-3	5.0-6.5	Split Spoon			25.0								16	Sandy CL	
	S-4	8.5-10.0	Split Spoon			22.8								11	Sandy CL	
	S-5	13.5-15.0	Split Spoon			20.7								7	Sandy CL	
MP-2	S-1	0.5-2.0	Split Spoon			3.5					49	19	30	53.3	17	Sandy CL
	S-2	2.5-4.0	Split Spoon			14.4								11	Sandy CL	
	S/U-3	5.0-6.5	Split Spoon	2.85	5.59	27.1	120.6	94.9	2.56					8	Sandy CL	
	S-4	8.5-10.0	Split Spoon			21.0								9	Sandy CL	
	S-5	13.5-15.0	Split Spoon			22.0								7	Sandy CL	
MP-3	S-1	0.5-2.0	Split Spoon			16.9								16	CL	
	S-2	2.5-4.0	Split Spoon			9.6								12	Sandy CL	
	S-3	5.0-6.5	Split Spoon			14.2								8	Sandy CL	
	S-4	8.5-10.0	Split Spoon			10.5								14	Sandy CL	
	S-5	13.5-15.0	Split Spoon			11.9								18	Sandy CL	
MP-4	S-1	0.5-2.0	Split Spoon			13.2					35	15	20		12	CL
	S-2	2.5-4.0	Split Spoon											16	Sandy CL	
	S-3	5.0-6.5	Split Spoon			17.2								7	Sandy CL	
	S-4	8.5-10.0	Split Spoon			20.2								16	Sandy CL	
	S-5	13.5-15.0	Split Spoon			13.8								10	Sandy CL	
PH-1	S-1	0.5-2.0	Split Spoon			25.9								6	FILL (CL)	
	S-2	2.5-4.0	Split Spoon			26.5								8	FILL (CL)	
	S-3	5.0-6.5	Split Spoon			18.3								20	FILL (CL)	
	S-4	8.5-10.0	Split Spoon			12.0								12	Sandy CL	



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SUMMARY OF FIELD AND LABORATORY TEST RESULTS

Project:	USD 320 High School Complex		
Location:	Wamego, Kansas		
Job Number:	1773023B	Date:	3/3/2017

1. Slabs-on-Grade 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.
 2. Foundations: Soil adjacent to and 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.
 3. Masonry: Treat voids.
 4. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.
- B. Post warning signs in areas of application.
- C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 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.

3.5 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of termite-control-treatment Installer. Include quarterly maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.
1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION 31 31 16