

Egner Hall Building 685

United States Military Academy

Association of Graduates

West Point, New York




PROJECT MANUAL

PROCUREMENT & CONTRACT REQUIREMENTS, PROJECT INFORMATION
DIVISION 1 THROUGH DIVISION 33

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DIVISION 0 – PROCUREMENT AND CONTRACTING REQUIREMENTS



















See Request for Proposal for all Procurement and Contracting Documents

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000115	List of Drawing Sheets			



















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01 10 02	Special Conditions			
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01 25 00	Substitution Procedures			
01 26 00	Contract Modification Procedures			
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01 31 00	Project Management and Coordination			
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01 33 00	Submittal Procedures			
01 35 16	Alteration Project Procedures			
01 40 00	Quality Requirements			
01 50 00	Temporary Facilities and Controls			
01 60 00	Product Requirements			
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01 78 23	Operation and Maintenance Data			
01 78 39	Project Record Drawings			
01 79 00	Demonstration and Training			

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02 08 00	Asbestos Abatement			
02 08 60	Remediation of hazardous and Universal Waste Articles			
02 10 00	Protection of Existing Utilities			
02 41 19	Selective Demolition			
02 83 00	Management of Lead Containing Paint			

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03 01 30	Concrete Repair – DRAWING SPEC NOTES ONLY			
03 20 00	Concrete Reinforcing			
03 30 00	Cast-in-Place Concrete			
03 30 10	Cast-In-Place Site Concrete			
03 54 13	Gypsum Cement Underlayment			

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04 20 00	Unit Masonry			
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05 31 00 Steel Decking			
05 50 00 Metal Fabrications			
05 52 13 Pipe and Tube Railings			
DIVISION 6 – WOODS, PLASTICS, AND COMPOSITES			
06 10 00 Rough Carpentry			
06 20 23 Interior Finish Carpentry			
DIVISION 7 – THERMAL AND MOISTURE PROTECTION			
07 21 00 Thermal Insulation			
07 21 29 Spray Applied Cellulose Acoustical Insulation			
07 52 16 Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing			
07 62 00 Sheet Metal Flashing and Trim			
07 72 00 Roof Accessories			
07 92 00 Joint Sealants			
07 92 19 Acoustical Joint Sealants			
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08 03 14 Historic Treatment of Wood Doors			
08 11 13 Hollow Metal Doors and Frames			
08 14 16 Flush Wood Doors			
08 17 13 Integrated Metal Door Opening Assemblies			
08 31 13 Access Doors and Frames			
08 33 23 Overhead Coiling Doors			
08 41 13 Aluminum-Framed Entrances and Storefronts			
08 51 13 Aluminum Windows			
08 71 00 Door Hardware			
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09 21 16.23 Gypsum Board Shaft Wall Assemblies			
09 22 16 Non-Structural Metal Framing			
09 29 00 Gypsum Board			
09 30 13 Ceramic Tiling			
09 51 13 Acoustical Panel Ceilings			
09 62 48 Isolated Concrete Flooring			
09 65 13 Resilient Base and Accessories			
09 65 19 Resilient Tile Flooring			
09 66 23 Resinous Matrix Terrazzo Flooring			
09 68 13 Tile Carpeting			
09 72 00 Wall Coverings			
09 84 33 Sound-Absorbing Wall Units			
09 84 36 Sound-Absorbing Ceiling Units			
09 91 13 Exterior Painting			
09 91 23 Interior Painting			
09 93 00 Staining and Transparent Finishing			
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10 14 23.16 Room-Identification Panel Signage			
10 22 13 Wire Mesh Partitions			
10 28 00 Toilet, Bath, and Laundry Accessories			
10 44 13 Fire Protection Cabinets			

	ISSUE 0	ISSUE 1	ISSUE 2
10 44 16 Fire Extinguishers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 11 – EQUIPMENT			
11 13 16 Loading Dock Seals and Shelters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11 13 19 Stationary Loading Dock Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11 61 23 Folding and Portable Stages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 12 – FURNISHINGS			
12 22 00 Curtains and Drapes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 13 – SPECIAL CONSTRUCTION			
13 11 13 Medium Isolation Sound Control Door Assemblies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13 34 73 High Isolation Sound Control Door Assemblies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 14 – CONVEYING EQUIPMENT			
14 21 23.16 Machine Room-Less Electric Traction Elevators	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 21 – FIRE SUPPRESSION			
21 05 00 Common Work Results for Fire Suppression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21 12 00 Fire Suppression Standpipes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 22 – PLUMBING			
22 05 00 Common Work Results for Plumbing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 05 23 General-Duty Valves for Plumbing Piping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 05 29 Hangers and Supports for Plumbing Piping and Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 05 53 Identification for Plumbing Piping and Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 07 00 Plumbing Insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 11 00 Facility Water Distribution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 11 23 Facility Natural Gas Piping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 13 00 Facility Sanitary Sewerage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 14 00 Facility Storm Drainage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 40 00 Plumbing Fixtures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING			
23 05 00 Common Work Results for HVAC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 05 03 Pipes and Tubes for HVAC Piping and Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 05 23 General-Duty Valves for HVAC Piping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 05 29 Hangers and Supports for HVAC Piping and Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 05 53 Identification for HVAC Piping and Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 05 93 Testing, Adjusting, and Balancing for HVAC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 07 00 HVAC Insulation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 22 16 Steam and Condensate Piping Specialties	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 31 00 HVAC Ducts and Casings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 33 00 Air Duct Accessories	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 34 00 HVAC Fans, Ventilators, and Accessories	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 36 00 Air Terminal Units	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 37 00 Air Outlets and Inlets	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 73 00 Packaged Rooftop Units	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 81 23 Computer Room Air Conditioners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 84 13 Electric to Steam Humidification System	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIVISION 25 – INTEGRATED AUTOMATION			
25 09 23 Facility Management and Control System	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

DIVISION 26 – ELECTRICAL

26 05 00	Common Work Results for Electrical	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 10	Work in Existing Building	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 19	Low-Voltage Electrical Power Conductors and Cables	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 26	Grounding and Bonding for Electrical Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 29	Hangers and Supports for Electrical Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 33	Raceways and Boxes for Electrical Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 48	Noise and Vibration Control for Electrical Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 53	Identification for Electrical Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 05 73	Arc Flash Hazard Analysis/Short-Circuit Coordination Study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 24 13	Low-Voltage Switchboards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 24 16	Panelboards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 27 16	Electrical Cabinets and Enclosures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 27 26	Wiring Devices	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 28 19	Enclosed Switches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 50 00	LED Lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26 80 00	Fire Detection and Alarm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

DIVISION 27 – COMMUNICATIONS

27 41 16.61	Integrated Audio-Video Systems and Equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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DIVISION 31 - EARTHWORK

31 25 00	Erosion and Sedimentation Controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31 90 00	Trench Excavation and Backfill	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 12 16	On-Site Asphalt Paving	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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DIVISION 33 – UTILITIES

33 00 00	Other Utilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33 10 00	Water Utilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33 40 00	Storm Drainage Utilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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H-104.00 ACM Identification Plan – 2nd Floor
H-105.00 ACM Identification Plan – 3rd Floor
H-106.00 ACM Identification Plan – Roofs

CIVIL

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A601 Exterior Door & Wall Details
A602 Roof Details
A700 Elevator Details Plans & Sections
A701 Exterior Stairs & Ramp Details
A800 Interior Elevations – Basement & First Floor Corridors
A801 Interior Elevations – Second Floor Corridors
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A803 Interior Elevations – Glee Club & Sectionals Rooms
A804 Interior Elevations – Cadet Spirit Band Room
A805 Interior Elevations – Concert Band Room
A900 Toilet Room Details
A901 Corridor Interior Details

A902 Glee Club Interior Details
A903 Concert Band Room Interior Details
A904 Ceiling Details

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S002 Special Inspection Tables
S100 Foundation Plans and Sections
S101 Roof Details
S200 Foundation Details and Sections
S300 Framing Details and Sections
S301 Framing Details and Sections
S400 Underpinning Details

MECHANICAL

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M101 First Floor Plan – Mechanical Demolition
M102 Second Floor Plan – Mechanical Demolition
M103 Third Floor Plan - Mechanical Demolition
M201 Partial Basement Floor Plan, Piping Relocation, & First Floor Plan – New Ductwork
M202 Second Floor Plan – New Ductwork & Sections
M203 Third Floor – Lower Level Ductwork & Upper Level Ductwork
M204 Roof Plan – New Ductwork & Section
M303 Third Floor Plan – Piping & Sections
M500 Details
M501 Details
M600 Schedules
M800 Control Diagram

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PCS2 Schedules and Notes
P100 Demolition Plans and Notes
P200 Basement Floor Plan
P201 First and Second Floor Plans
P202 Third Floor and Roof Plans

ELECTRICAL

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E101 First Floor Plan – Electrical Demolition
E102 Second Floor Plan – Electrical Demolition
E103 Third Floor Plan – Electrical Demolition
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E201 First Floor Plan – Electrical Power
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E900	Lighting Fixture & Control Notes
E901	Lighting Fixture Schedule & Diagrams
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XV001	AV System Equipment: Demolition Plans
XV101	AV System Equipment: Plans Level 2 & 3 Glee Club, Band Room
XV102	AV System Equipment: RCP Level 2 Glee Club, Band Room
XV103	AV System Equipment: Glee Club Room Elevations
XV104	AV System Equipment: Concert Band Room Elevations

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Project information.
- 2. Work covered by Contract Documents.
- 3. Phased construction.
- 4. Future work not part of this Project.
- 5. Contractor's use of site and premises.
- 6. Work restrictions.
- 7. Specification and Drawing conventions.
- 8. Miscellaneous provisions.

- B. Related Requirements:

- 1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
- 2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

- A. Project Identification: Egner Hall Building 685.

- 1. Project Location: United States Military Academy, West Point, New York.

- B. Owner: West Point Association of Graduates and the United States Military Academy.

- 1. Owner's Representative: Tectonic Engineering.

- C. Architect: Mark B. Thompson Associates Architecture.

- D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Structural Engineering: Keast & Hood Company of New York, PC.
 2. Mechanical, Electrical, Plumbing, Fire Protection Engineering: Dimitri J. Ververelli, Inc.
 3. Civil Engineering: Langan.
 4. Acoustical Design: Theatre Projects.
- E. Contractor: To be selected.
- F. Owner Representative: Hill International.
1. Owner Representative has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.
 2. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.
- G. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.
1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
1. The Egner Hall – Building 685 Project includes Alteration (Level 2) of selective areas within the Use Group B (Business) facility. The building is a 3-story building with basement, with cast-in-place concrete structure and masonry exterior walls. Alteration Work, approximately 15,000 square feet, includes:
 - a. Glee Club rooms on the 2nd floor, south side.
 - b. Spirit Band Room on the 2nd floor, north side.
 - c. Concert Band Room, Band Library, Control Room on the 3rd floor.
 - d. Support spaces on 1st, 2nd, and 3rd floors.
 - e. Circulation and egress facilities serving the renovated areas.
 - f. Mechanical, electrical, plumbing, and fire protection systems serving the renovated areas.
 - g. Site and utility improvements at the west entrance and loading zone.
 - h. Hazardous material remediation for the renovated areas.
 - i. Other Work indicated in the Contract Documents.
 2. The project will be implemented as separate Bid Packages. See Separate Bid Package descriptions on drawing CS2.
 3. Each Bid Package includes Alternates. See descriptions on drawing CS2 and Division 1 Section Alternates.
- B. Type of Contract:
1. Each Bid Package will be constructed under a single prime contract.

1.6 WORK UNDER OWNER'S SEPARATE CONTRACTS

- A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.
- B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.
 - 1. New Electrical Service to Egner Hall: City Light and Power
 - 2. Relocation of Water Main in Street: American Water
 - 3. Bid Package No. 2: Elevator, West Entrance, and Loading Platform

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits on Use of Site: Confine construction operations to areas of renovation and alteration shown on the Drawings.
 - 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- B. 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.
- C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

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

- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 - 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 - 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.9 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:45 a.m. to 4:30 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Non-Working Hours: See Special Conditions.
- C. On-Site Work Day Restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during work black-out days identified by the Owner.
- D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Owner Representative not less than seven days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner Representatives not less than seven days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.
- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

- H. Employee Screening: Comply with Owner's requirements for screening of Contractor personnel working on Project site.
 - 1. See Special Conditions.
 - 2. Contractor and subcontractor personnel shall be required to complete USMA Form 13-16.
 - 3. Maintain list of approved screened personnel with Owner's representative.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 - 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 - 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.11 MISCELLANEOUS PROVISIONS

- A. See Special Conditions for additional provisions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SAFETY OVERVIEW

- A. The Contractor and all lower-tier subcontractors shall be responsible for the safety and security of employees under their control and as to their area of work and will submit a copy of their specific safety program to the Owner's Representative, prior to start up.
- B. The Owner recognizes that it is important to prevent the occurrence of incidents that lead to occupational injuries or illnesses. Contractor is responsible for Safety and Health requirements on this project which include, but are not limited to, the following:
 - 1. In general, this accident prevention policy is based on a sincere desire to eliminate personal injuries, occupational illnesses, and equipment and property damage; and to protect the general public exposed to or associated with the work.
 - 2. The importance of safety on the project shall be recognized, and accident prevention shall be an integral part of all operations.
 - 3. Contractor and its lower-tier subcontractors shall conduct work in a safe and practical manner and shall observe all applicable Federal, State, USMA and local laws/regulations pertaining to Safety, Health, pollution control, water supply, fire protection, sanitation facilities, waste disposal and other related items.
 - 4. The Mandatory Safety and Health Rules shall be posted in a conspicuous location along with current OSHA and Emergency Phone Number Posters.
 - 5. Comply with all applicable health and safety regulations at all times.
 - 6. Good housekeeping shall be observed at all times. Waste, debris, garbage shall be removed daily or placed in appropriate waste containers. All materials, tools and equipment shall be stored in a safe and orderly fashion.

7. Contractor shall indoctrinate its employees and lower-tier subcontractors as to the safety and health requirements and to enforce adherence to safe work procedures.
8. Contractor is responsible for weekly safety inspection and reports.

1.03 DUTIES OF CONTRACTOR

A. SAFETY PROGRAM

1. Contractor and/or its lower-tier subcontractors shall be required to submit their company Safety Program to the Owner's Representative for review before starting any work.
2. Contractor shall provide a written Site Safety Program, maintain injury records as required by OSHA or other regulatory authorities, and make available to the Owner's Representative's representative information on injury logs, safety meetings, inspection reports and other items concerning project safety. The Owner's Representative will be kept informed of all serious and/or lost time injuries.
3. Contractor shall assign an individual to act as the full-time site safety representative who will have the responsibility to resolve matters concerning safety and to act as liaison among its lower-tier subcontractors. This individual must have the authority necessary to correct unsafe or hazardous conditions or practices
4. Contractor will inform the Owner's Representative's of any Federal or State inspection, and the Owner's Representative's will receive copies of all Federal and State inspection reports, citations, penalties, abatement dates, etc.

B. SITE SAFETY INSPECTIONS & REPORTS

1. Contractor will employ a site safety manager who will inspect the site on a regular basis and provide a report to the Owner.
2. The report will be made weekly and detail all unsafe conditions and recommends corrective action. Photographs will be used to document each event.

C. EMPLOYEE SAFETY ORIENTATION AND SAFETY MEETINGS:

1. Contractor and its lower-tier subcontractors shall follow OSHA Act 1926.21(2) requirements that state: "that each employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment."

2. Each tradesman that works on this project shall attend a basic safety orientation, to be given by Contractor, and sign in with records kept of attendees.
3. Contractor shall provide site and safety indoctrination to each employee as he/she begins work on the project. This indoctrination will cover general safety rules, potential hazards, site work rules, wearing of protective equipment, etc. Documentation of attendance at the mandatory briefing is required.
4. Tool Box Meetings will be held weekly and each tradesman shall attend. It is the responsibility of Contractor and/or its lower-tier subcontractors to maintain the following documentation: date, topic discussed, meeting chairman, names of personnel who were present, names of personnel who were absent, trade and/or Contractor name.

D. ACCIDENTS / REPORTS

1. In the case of an injury to an employee of the Contractor or its lower-tier subcontractors involving lost time beyond the date of the injury, the Contractor shall furnish the Owner's Representative a copy of the first Report of Injury, Injury Report filed with the insurance company and a Foreman's Accident Report within 24 hours after the occurrence.
2. All recordable occupational injuries and illnesses, other than First Aid cases, as required by the regulations issued under the Occupational Safety and Health Act of 1987 shall be recorded on the OSHA Form 300 each month and a copy forwarded to the Owner's Representative.
3. Contractor will provide and maintain at the Project first aid equipment and supplies.
4. Contractor or its lower-tier subcontractors shall supply the proper equipment, take the necessary precautions to maintain the equipment according to the current regulations and specifications, and accept responsibility to assure that necessary safety equipment is supplied and used when required.

1.04 FAILURE TO COMPLY WITH SAFETY REGULATIONS

- A. Failure to comply with the safety requirements will be considered as non-compliance with the Contract and will result in remedial action. This remedial action may include the Owner or its authorized representative/Owner's Representative taking whatever action is necessary to repair or make safe the unsafe condition and back-charge the Contractor as necessary. In addition, if the Contractor continues to practice unsafe behavior, the Owner or its authorized representative/Owner's Representative, may levy a fine of \$5,000.00 per

1.05 CONTRACTOR'S RESPONSIBILITY

- A. The Owner, Architect, Engineer and Owner's Representative shall in no way be responsible for the Contractor's means, methods, or techniques of construction, nor for any safety precautions or procedures on this project.

END OF SECTION 011001

SECTION 011001 – SPECIAL CONDITIONS

1.0 GENERAL

1.1 Notification:

The Contractor must notify West Point Association of Graduates, the United States Military Academy, Owner's Representative, Architect, and the Corps of Engineers (COE) at least 14 days in advance of commencing work. The Contractor must also coordinate with all COE Dig Safe Requirements. The Contractor's written notification to COE through Hill must contain, at the minimum, the following information:

REASON FOR DIG:
MAP/SKETCH:
ANTICIPATED DIGGING DEPTH:
ANTICIPATED DIGGING DATE:
APPROXIMATE NUMBER OF SOIL BORINGS:

1.2 Contact Information: The COE contact for this Project is through the Director of Public Works (DPW), Louis Cirillo, DPW Project Manager and Architect.

Via E-mail: louis.a.cirillo.civ@army.mil

2.0 PERFORMANCE RESTRICTIONS

2.1 Working Hours: Normal working hours shall be Mondays to Fridays 0700 to 1530 hours. Differences to these working hours must be approved by COE.

2.2 Non-Working Hours: During the course of this Contract the Contractor shall not perform any physical work on the days/periods listed below:

- a) Graduation Week: A seven day period starting the Sunday before graduation. This is usually the end of May.
- b) Reception Day: A single day in the end of June or early July when the new Cadet class arrives.
- c) Football Home Games: Up to seven home football games per year. Exact dates will be furnished to the Subconsultant on request in the year that they will occur.
- d) All Government Holidays.
- e) The Contractor should anticipate ten (10) additional days each calendar year on which no physical work shall be performed. These will be at the Government's discretion (Code Red and/or Code White). The actual "No-Work" days will be confirmed by the Government during the work phase in conjunction with the construction plan approval. The Contractor's schedule must reflect the above anticipated "no work" days.
- f) The Contractor should anticipate five (5) additional days each calendar year on which no physical work shall be performed due to weather related conditions.

3.0 FORCE PROTECTION CONDITIONS CLAUSE (FPCON's)

During higher Force Protection Conditions (FPCON's) Contractor, its employees and subcontractors are required to comply with all Antiterrorism policies and procedures while on the installation. Contractor personnel may be directed to enter the installation through certain access control points where they can best be identified and searched. Contractor personnel may be prohibited from certain portions of the installation during exercises and actual emergencies.

- a) Contractor will comply with parking restrictions and will not park in unauthorized parking areas or within 82 feet of an inhabited building when directed.
- b) Access control roster (personnel and vehicles) must be provided. Names / vehicles verified by the company and received background screening. Substitutes receive same vetting process prior to work.
- c) All contractor personnel and vehicles are subject to search while on the installation
- d) In the event of an identified restricted/exclusion area, the contractor personnel will not be authorized without specific permission or an escort.
- e) Access may be denied during increased readiness or Force Protection Conditions (FPCON's).
- f) Contractor shall comply with USMA Identification For Contractor Personnel and USMA Form 13-16 Personnel Background Check Form, both set forth in the Information Available To Bidders.

4.0 ALIEN EMPLOYMENT CLAUSE

The Contractor shall not employ any alien who does not have a valid US Immigration I-551 or I-94. The Contractor shall provide valid social security numbers and citizenship status of all employees to the Government, upon request.

5.0 E-VERIFY CLAUSE

E-Verify is an Internet based system operated by the Department of Homeland Security (DHS) in partnership with the Social Security Administration (SSA) that allows participating employers to electronically verify the employment eligibility of their newly hired employees. E-Verify is currently free to employers and is available in all 50 states. E-Verify provides an automated link to federal databases to help employers determine employment eligibility of new hires and the validity of their Social Security numbers. E-Verify are the best means for determining employment eligibility of new hires and the validity of their Social Security numbers. Contractor shall use E-Verify on all employees that will be working on this installation, under this Contract. This shall be done prior to the employee starting work on the installation. For E-Verify information: www.dhs.gov/E-Verify or call 1-888-464-4218.

6.0 TEMPORARY HEAT

GENERAL

Definition - The provision of Temporary Heat shall mean the provision of heat in order to permit construction to be performed in accordance with the Progress Schedule during all seasons of the year and to protect the work from the harmful effects of low temperature. In the event the building, or any portion thereof, is occupied during construction, the provision of Temporary Heat shall include the provision of heat to permit normal operations in such occupied areas.

The provision of Temporary Heat shall include the provision of: 1) all fuel necessary and required, 2) all equipment necessary and required, and 3) all operating labor necessary and required. Operating labor shall mean that minimum force required for the safe day to day operation of the system for the provision of Temporary Heat and shall include, without limitation, heating maintenance labor and/or Firewatch as required by Fire Department regulations. Operating labor may be required seven (7) days per week and during other than normal working hours, for the period of time required by seasonal weather conditions.

Responsibility – The Contractor will be responsible for the provision of Temporary Heat, and all expenses in connection therewith.

TEMPERATURE REQUIREMENTS

Unoccupied Buildings - The temperature requirement for the provision of Temporary Heat in unoccupied buildings shall be the GREATER of the following: 1) 50 degrees Fahrenheit, or 2) the temperature requirement for the particular type of work set forth in the Contract Documents.

Occupied Buildings - The temperature requirement for the provision of Temporary Heat in occupied buildings, or portions thereof, shall be the GREATER of the following: 68 degrees Fahrenheit or the temperature requirement for the particular type of work set forth in the Contract Documents.

DURATION

The total Contract duration is set forth in consecutive calendar days of the General Conditions. The Table set forth below indicates the number of full heating seasons that are deemed included in various contract durations, which are specified in consecutive calendar days (ccds). At a minimum, a full heating season shall extend from October 15th to April 15th.

Contract Duration	Full Heating Seasons Required
	up to 360 ccds1 full heating season
	360 to 720 ccds2 full heating seasons
	more than 720 ccds3 full heating seasons

All winter conditions, including but not limited to snow cleaning, hot water, winter blank kit, enclosures are including in the base bid and is at the contractor sole expense.

7.0 ACCEPTANCE TESTS

- a) GOVERNMENTAL AGENCIES - All equipment and appliances furnished and installed under the Contract shall conform with the requirements of the Specifications, and shall in no event be less than that necessary to comply with the minimum requirements of the law and all of the governmental agencies having jurisdiction.
- b) NOTICE OF TEST - Whenever the Specifications and/or any governmental agency having jurisdiction requires the acceptance test, the Contractor shall give written notice to all concerned of the time when these tests will be conducted.
- c) LABOR AND MATERIALS - The Contractor shall furnish labor and all other material and instruments necessary to conduct the acceptance tests at no additional cost to the WPAOG.
- d) CERTIFICATES - The final acceptance by the Owner shall be contingent upon the Contractor delivering to the Owner all necessary certificates evidencing compliance in every respect with the requirements of the regulatory agencies having jurisdiction.
- e) RESULTS - If the results of tests and Controlled Inspections indicate that the material or procedures do not meet requirements as set forth on the Contract Drawings or in the Specifications or are otherwise unsatisfactory, the Contractor shall only proceed as directed by the Owners Representative. Additional costs resulting from retesting, reinspecting, replacing of material and/or damage to the work of other trades and any delay caused to the schedule shall be borne by the Contractor.

8.0 GUARANTEES AND WARRANTIES

FORM - The Contractor shall furnish written guarantees for such work as required by the Specifications, in the form set forth on the page following.

GUARANTY

WPAOG/WPUSMA PROJECT #

PROJECT DESCRIPTION

CONTRACT #

SPECIFICATION SECTION # AND TITLE

GUARANTY TO BE IN EFFECT FROM

TO

The Contractor hereby guarantees that the work specified under the above section of the aforesaid Contract will be free from defects of material and/or workmanship, for the period indicated above.

The Contractor also guarantees that it will promptly repair, restore, rebuild or replace whichever may be deemed necessary by the WPAOG & WPUSMA, any or all defective material or workmanship of the aforementioned section, that may appear within the guaranty period and any finished work to which damage may occur because of such defects, to the satisfaction of the WPAOG/WPUSMA and without any cost or expense to the WPAOG/USMA.

The Contractor hereby agrees to pay to the WPAOG/USMA the cost of the repairs or replacements should the WPAOG/USMA make the same because of the failure of the Contractor to do so.

Contractor

By

Subscribed and sworn to before me this

day of _____, year _____

Notary Public

9.0 RODENT AND INSECT CONTROL

Unless directed otherwise by the Owner, the Contractor shall furnish and pay for the services of a licensed exterminating company, approved by the Owner, from the time the work is started until the project is finally accepted by the WPAOG, for the purpose of maintaining exterminating service for the correction and control of rats, mice, roaches and water beetles. The exterminating company shall provide all labor, materials and equipment

necessary to maintain complete exterminating service in the project under construction and the surrounding ground areas within the boundary lines of the site which shall include all shanties of all Contractors, temporary toilets and the field offices of other Contractors.

MATERIALS, EQUIPMENT AND PROCEDURES - used for exterminating purposes shall comply in all respects with the rules and regulations of the New York WPAOG Department of Health, OSHA, and the laws, ordinances and regulations of State and Federal Agencies pertaining to such chemical and/or materials.

INSPECTIONS AND TREATMENTS - by Service Operators of the exterminating company of the above mentioned projects and ground area, are to be made on a set day once each week during the regular work day hours (Monday through Friday), for rats, mice, roaches and water beetles, with special attention to the following condition and/or areas.

- a) Wet areas inside and/or outside the project, including all temporary structures.
- b) All exterior temporary toilet structures and the temporary toilet facility areas when erected on the interior of the project.
- c) Field Offices and shanties of all Contractors.
- d) Wherever there is evidence of food waste and/or discarded food or drink containers in quantity that would cause breeding of rodents or the insects herein specified.
- e) Any other portion of the premises requiring such special attention.

10.0 MAINTENANCE OF PROJECT SITE

- a) Take over and maintain all project areas, after order to start work.
- b) Until the work of the Contract is completed and accepted, the Contractor shall be responsible for the safety of all project areas, including water, gas, electric and other mains and pipes and conduits and shall at the Contractor's own expense, except as otherwise specified, protect same and maintain them in at least as good condition as that in which the Contractor finds them.
- c) All pavements, sidewalks, roads and approaches to fire hydrants shall be kept clear at all times, maintained, and if damaged, repaired to serviceable conditions with materials to match existing.
- d) Snow removal and clearing all site drainage is part of the contractor scope of work.

END OF SECTION 011002

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SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES – BID PACKAGE NO. 1: BUILDING RENOVATION

- A. Bid Package No. 1 includes all Work not included in Bid Package No. 2.
 - 1. On applicable drawing sheets, Bid Package No. 2 Work is identified. All Work not identified as Bid Package No. 2 shall be included with Bid Package No. 1.
- B. Bid Package No. 1 Alternates:
 - 1. Alternate No. 1.1: Cadet Spirit Band Room Renovation.
 - a. Base Bid: No Cadet Spirit Band Room Work included.
 - b. Alternate: Provide Cadet Spirit Band Room renovation, including all general construction, mechanical, and electrical Work shown for Room 214.
 - 2. Alternate No. 1.2: Humidification Systems.
 - a. Base Bid: No humidification system Work included.
 - b. Alternate: Provide humidification systems to service Glee Club Room 203 and Concert Band Room 300.
 - 3. Alternate No. 1.3: Bid Package No. 2.
 - a. Base Bid: No Bid Package No. 2 Work included.
 - b. Alternate: Provide Bid Package No. 2, not including Alternate No. 2.1.
 - 4. Alternate No. 1.4: Bid Package No. 2 Alternate No. 2.1.
 - a. Base Bid: No Bid Package No. 2 Alternate Work included.
 - b. Alternate: Provide all Work related to extending elevator to Basement level, including all demolition and new Work shown for Rooms B-9, B-10, B-18, and basement level of hoistway.

3.2 SCHEDULE OF ALTERNATES – BID PACKAGE NO. 2: ELEVATOR, WEST ENTRANCE, AND LOADING PLATFORM

- A. Bid Package No. 2 includes all Work not included in Bid Package No. 1.
 - 1. On applicable drawing sheets, Bid Package No. 2 Work is identified. All Work not identified as Bid Package No. 2 shall be included with Bid Package No. 1.
- B. Bid Package No. 2 Alternates:
 - 1. Alternate No. 2.1:
 - a. Base Bid: No Bid Package No. 2 Alternate Work included.

- b. Alternate: Provide all Work related to extending elevator to Basement level, including all demolition and new Work shown for Rooms B-9, B-10, B-18, and basement level of hoistway.

END OF SECTION 012300

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Architect.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from applicable code organizations.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Owner Representative of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty at least "of equal" to the original scope item.
 - 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 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 10 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

e. Quotation Form: Use forms acceptable to Owner Representative.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to. Contractor shall notify Owner Representative within five days from when Contractor becomes aware of such conditions.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Owner Representative.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Owner Representative will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect or Owner Representative may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 WORK CHANGE DIRECTIVE

A. Work Change Directive: Architect may issue a Work Change Directive on EJDC Document C-940. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Section 013200 "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 items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through Owner Representative in coordination with preparation of Agreement Between Owner and Contractor.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.

- f. Contractor's name and address.
 - g. Date of submittal.
- 2. Arrange schedule of values consistent with format of AIA Document G703.
- 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Change Orders (numbers) that affect value.
 - d. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
- 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
- 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
- 6. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
- 7. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 8. 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 Owner Representative and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Owner Representative and Owner. Submit forms for approval with initial submittal of schedule of values.

- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Owner Representative 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 signed and notarized Application for Payment to Owner Representative by a method ensuring receipt. Include waivers of lien and similar attachments if required.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Submittal schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
 13. Performance and payment bonds.

14. Data needed to acquire Owner's insurance.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. 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, complying with the Contract Documents, including Division 1 Sections "Closeout Procedures", "Operation and Maintenance Data", "Project Record Drawings", and "Demonstration and Training."
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. 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.
 10. Proof that taxes, fees, and similar obligations are paid.
 11. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities including, but not limited to; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, and in web-based Project software directory. 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.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. 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 panel system and/or structural elements. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
3. 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, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
4. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, and pipe drops.
5. Structural Elements: Show the following:
 - a. Locations, top and bottom elevations, and dimensions of exposed structural elements.

6. Review: Architect and Owner Representative will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect and Owner Representative determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Owner Representative will so inform Contractor, who shall make suitable modifications and resubmit.

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Fire Protection, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Protection Installer will locate piping and equipment, using red color. Fire Protection Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 - b. DWG , operating in Microsoft Windows operating system.
2. File Submittal Format: Submit or post coordination drawing files using PDF format.
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in AutoCAD 2022.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.

2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Architect and Owner Representative.
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's and Owner Representative's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect or Owner Representative after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect and Owner Representative 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 012600 "Contract Modification Procedures."

- a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner Representative 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 monthly. Use software log that is part of web-based Project management software. Software log with not less than the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect and Owner Representative.
 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 and Owner Representative response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's and Owner Representative's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Owner Representative within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's CAD drawings will be provided by Architect for Contractor's use during construction.
 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in AutoCAD 2022.
 4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
 - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.
 5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
- B. Web-Based Project Management Software Package: Provide, administer, and use Contractor's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
 1. Web-based Project management software includes, at a minimum, the following features:

- a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. 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.
 - d. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - e. Processing and tracking of payment applications.
 - f. Processing and tracking of contract modifications.
 - g. Creating and distributing meeting minutes.
 - h. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - i. Management of construction progress photographs.
 - j. 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.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Owner Representative 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 a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to all attendees.
- B. Preconstruction Conference: Owner Representative will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Owner Representative, 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. Critical work sequencing and long lead items.
- d. Designation of key personnel and their duties.
- e. Lines of communications.
- f. Use of web-based Project software.
- 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. Sustainable design requirements.
- n. Preparation of Record Documents.
- o. Use of the premises and existing building.
- p. Work restrictions.
- q. Working hours.
- r. Owner's occupancy requirements.
- s. Responsibility for temporary facilities and controls.
- t. Procedures for moisture and mold control.
- u. Procedures for disruptions and shutdowns.
- v. Construction waste management and recycling.
- w. Parking availability.
- x. Office, work, and storage areas.
- y. Equipment deliveries and priorities.
- z. First aid.
- aa. Security.
- bb. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Owner Representative, and Owner's Commissioning Authority of scheduled meeting dates.
- 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.

- j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Owner Representative will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 60 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Owner Representative, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Owner's partial occupancy requirements.

- m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
- 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at biweekly intervals.
 - 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Owner Representative, 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) Status of sustainable design documentation.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
 - 2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 DEFINITIONS

- A. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time belongs to Owner and is for the exclusive use or benefit of the Owner.
- B. Resource Loading: The allocation of manpower and equipment necessary for completing 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.
 - 2. PDF file.
- B. Site Condition Reports: Submit at time of discovery of differing conditions.
- C. Unusual Event Reports: Submit at time of unusual event.

1.5 COORDINATION

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

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 - 1. Use scheduling component of Project management software package specified in Section 013100 "Project Management and Coordination," or other scheduling software package acceptable to Owner's Representative for current Windows operating system.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Owner's Representative.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 - 3. Procurement Activities: Include procurement process activities for long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 - 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Owner Representative administrative procedures necessary for certification of Substantial Completion.

7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Work 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.
 2. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Submittals.
 - b. Mockups.
 - c. Deliveries.
 - d. Installation.
 - e. Tests and inspections.
 - f. Startup and placement into final use and operation.
 - g. Commissioning.
 3. 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.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- G. 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.

- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 STARTUP CONSTRUCTION SCHEDULE

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

1.8 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.9 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup 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 inspection.
 - j. Commissioning.
 - k. Punch list and Final Completion.
 - l. 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.
- D. 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.
- E. 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).
- F. 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.

1.10 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Construction Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. 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.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
 - 4. Final Completion construction photographs.
 - 5. Preconstruction video recordings.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.

1.3 INFORMATIONAL SUBMITTALS

- A. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name of Contractor.
 - c. Date photograph was taken.
 - d. Description of location, vantage point, and direction.
- B. Video Recordings: Submit video recordings within seven days of recording.
 - 1. Submit video recordings by uploading to web-based Project management software site.
 - 2. Identification: With each submittal, provide the following information in file metadata tag:
 - a. Name of Project.
 - b. Name of Contractor.

- c. Date video recording was recorded.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time from camera.
- E. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag excavation areas and construction limits before taking construction photographs.
 - 2. Take a minimum of 100 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take a minimum of 100 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
 - 5. Waterproofing and weather-resistant barriers.
- D. Periodic Construction Photographs: Take minimum of 100 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
 - 1. Submit Periodic Construction Photographs at monthly intervals with each Application for Payment

1.6 CONSTRUCTION VIDEO RECORDINGS

- A. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Owner Representative.
1. Flag excavation areas and construction limits before recording construction video recordings.
 2. Show existing conditions adjacent to Project site before starting the Work.
 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
 4. Show protection efforts by Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making

corrections or revisions to submittals noted by Architect and Owner Representative and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's and Owner Representative's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect and Owner Representative the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Owner Representative's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Owner Representative will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 - 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review

of each submittal. Submittal will be returned to Owner Representative before being returned to Contractor.

- a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect and Owner Representative.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Standard color charts.
 - c. Statement of compliance with specified referenced standards.
 - d. Testing by recognized testing agency.
 - e. Application of testing agency labels and seals.
 - f. Notation of coordination requirements.
 - g. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

- a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
- 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Owner Representative, will return submittal with options selected.
 - 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect and Owner Representative will retain two Sample sets; remainder will be returned.

- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- F. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified, and copies of license/certification.
- G. Test and Research Reports:
1. 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.
 2. 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.

1.7 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Owner Representative.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 013516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep an element or detail secure and intact.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- B. Fire-Prevention Plan: Submit 30 days before work begins.

1.5 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

1.6 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 2. Pack or crate items after cleaning; cushion against damage during handling. Label 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.
- B. Salvaged Materials for Reinstallation:
 1. Repair and clean items for reuse as indicated.

2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label 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 unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 2. Secure stored materials to protect from theft.
 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.
- E. Storage Space:
1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space may not include security and climate control for stored material.
 2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.7 FIELD CONDITIONS

- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of field measurement of specific conditions, preconstruction photographs and preconstruction videotapes.
1. Comply with requirements specified in Section 013233 "Photographic Documentation."
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Owner's Removals: Before beginning alteration work, verify in correspondence with Owner's Representative items that will be removed from the work areas.
- D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 - 1. Use only proven protection methods, appropriate to each area and surface being protected.
 - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - 3. Erect temporary barriers to form and maintain fire-egress routes.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 - 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
 - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

- F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.

- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Use of open-flame equipment is not permitted. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at each area of Project site until two hours after conclusion of daily work.

- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 013233 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 013516

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, Owner Representative or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:

- a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
- 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
- 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Owner Representative.
- 1.4 DELEGATED DESIGN SERVICES
 - A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
 - B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Reports: Prepare and submit certified written reports and documents as specified.
- C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- 1.8 QUALITY ASSURANCE
- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the

kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups of size indicated.
 - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 - 3. Notify Architect and Owner Representative 14 days in advance of dates and times when mockups will be constructed.
 - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
 - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 - 7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
 - 8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 10. Demolish and remove mockups when directed unless otherwise indicated.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect Owner Representative, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect Owner Representative, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of

materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. 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 inspection equipment at Project site.

- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner[, as indicated in the Statement of Special Inspections included on the Drawings.

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, Commissioning Authority's, Owner Representative's, and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. 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. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 - 3. Indicate methods to be used to avoid trapping water in finished work.
- F. 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 United States Access 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.
- B. Occupied Facilities: Portions of the existing building will remain in operation during the construction period. Provide temporary services to maintain lighting and electrical power, fire protection, dust control, and temperature and humidity control for the duration of construction and until permanent services are restored.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, 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[, .
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- C. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches (914 by 1524 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: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Owner Representative, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 - 5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "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 TEMPORARY FACILITIES, GENERAL

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

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line(s) for the field office use.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Owner Representative office.
 - g. Engineers' offices.
 - h. Owner's office.
 - i. Principal subcontractors' field and home offices.

- I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
- J. Project Computer: Provide a computer in the primary field office to access Project electronic documents and maintain electronic communications.
 - 1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 - 2. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall.
 - 3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 - 2. Utilize designated area within existing building for temporary field offices.
 - 3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- D. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. 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.
 - 2. Maintain and touch up signs, so they are legible at all times.
- 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.

- H. Existing Elevator Use: Use of Owner's existing elevators will not be permitted.
- I. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 312500 "Erosion and Sedimentation Controls".
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

- G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As 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 workday.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- L. Temporary 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. Comply with additional limits on smoking specified in other Sections.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. 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.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work from wetting and exposure and to airborne mold spores.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012300 "Alternates" for products selected under an alternate.
 - 3. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 4. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability,

visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

- B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

- C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect and Owner Representative in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
 - 1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 - 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

- a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
- 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
- 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
- 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
- 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
- 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
 1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination of Owner's separate contracts, and limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to submitting cutting and patching plan, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Owner's Representative of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.

- b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
- 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.5 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.
- 3.2 PREPARATION
- A. Existing Utility Information: Furnish information to local utility or Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 FIELD ENGINEERING

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect and Owner Representative. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Owner Representative before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that

adequate provisions are made for locating and installing products to comply with indicated requirements.

- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.7 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect and Owner Representative. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's and Owner Representative's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Owner Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.
 3. Certificate of Substantial Completion shall list any claims the Contractor may have.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Owner Representative will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Owner Representative.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel Electronic File: Architect, through Owner Representative, will return annotated file.
 - b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. 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. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. 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.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

- o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
- r. Clean strainers.
- s. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.
- 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 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. 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 draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single electronic file.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. 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.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.7 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Gas leak.
 3. Water leak.
 4. Power failure.
 5. Water outage.
 6. System, subsystem, or equipment failure.
 7. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.

4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.

- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and PDF printed record digital data files.
 - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and PDF printed record digital data files.
 - 2) Include each drawing, whether or not changes and additional information were recorded.
- B. 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.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Owner Representative. Prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.

4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file.
 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 Owner Representative.
 - e. Name of Contractor.

1.5 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.

1.6 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Owner Representative's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.4 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 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect and Owner's Representative.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.

- g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. 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 Owner Representative, with at least fourteen 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. 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.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
 - 1. Submit video recordings on CD-ROM or thumb drive.
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.

- b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

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SECTION 020110 – MAINTENANCE OF EXISTING CONDITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Project Specifications:
 - 1. Section 02 10 00 – Protection of Existing Utilities
 - 2. Section 31 25 00 – Erosion and Sediment Control
- C. Project Documents:
 - 1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide maintenance of existing conditions in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
 - 1. Protection of existing conditions during construction operations
 - 2. Repair of any damage during construction operations

1.4 PROJECT CONDITIONS

- A. Structures to be removed will be discontinued in use and vacated prior to start of work.
- B. Owner assumes no responsibility for condition of structures to be removed.
- C. Conditions existing at time of inspection for bidding purposes will be maintained by Owner as reasonably practical. Variations within structures may occur by Owner's removal and salvage operations prior to start of demolition work.
- D. Unless otherwise indicated in Contract Documents or specified by the Owner, items of salvageable value to Contractor shall be removed from site and structures. Storage or sale of removed items on site will not be permitted and shall not interfere with other work specified.

- E. Explosives shall not be brought to site or used without written consent of authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to persons or for damage to property due to blasting operations. Performance of required blasting shall comply with governing regulations.

F.

1.5 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Owner.
- B. The Contractor must provide the following submittals to the Owner for approval prior to purchase of materials:
 - 1. Material Certificates: Submit materials certificate to the Owner's which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.
 - 2. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.

1.6 CONTRACTOR RESPONSIBILITIES

- A. General coordination with other trades, Owner, etc.
- B. Contractor is responsible for protecting existing conditions during construction as necessary.
- C. Identify and describe to the Engineer and design team unexpected variations to subsoil conditions and the discovery of uncharted utilities.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.

1.8 PERMITS AND APPROVALS

- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work authorized by the permit.

1.9 PROJECT RECORD DOCUMENTS

- A. The contractor shall accurately record any structures which exist on site and are not shown on the contract documents.
- B. A pre-construction and post-construction survey of the conditions within the project limits to remain during construction shall be performed by the Contractor.

1.10 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
 - 1. New York State Department of Environmental Conservation rules, regulations and guidelines pertaining to erosion and sediment control and stormwater management.
 - 2. United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.

PART 2 - EXECUTION

2.1 GENERAL DEMOLITION REQUIREMENTS

- A. Demolish site improvements designated to be removed as shown on the drawings. Site improvements shall include but not be limited to structures, retaining walls, foundations, pavements, curbs and gutters, drainage structures, utilities, signage or landscaping.
- B. Disconnect and cap or remove utilities to be abandoned as shown on the contract drawings. Obtain written approval from utility providers and West Point Department of Public works, and record cap location.
- C. Fill or remove underground tanks, septic tanks, piping, and appurtenances as shown on the contract drawings.

2.2 FILLING VOIDS

- A. Completely fill below grade areas and voids resulting from demolition or removal of structures, underground fuel storage tanks, septic tanks, wells, cisterns, etc., using aggregate fill materials consisting of stone, gravel, or sand, free from debris, trash, frozen materials, roots, and other organic matter.
- B. Areas to be filled shall be free of standing water, frost, frozen or unsuitable material, trash, and debris prior to fill placement.
- C. Grade surface to match adjacent grades and to provide flow of surface drainage after fill placement and compaction.

2.3 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove debris, rubbish, and other materials resulting from demolition operations from site. Leave areas of work in clean condition.
- B. No burning of any material, debris, or trash on-site or off-site will be allowed except when allowed by appropriate authority having jurisdiction and Owner. If allowed as stated above, burning shall be performed in manner prescribed by governing authority. Attend burning materials until fires have burned out and have been completely extinguished.
- C. Transport materials removed from demolished structures with appropriate vehicles and dispose off-site to areas that are approved for disposal by governing authorities and appropriate property owners.

2.4 PROTECTION

- A. The Contractor shall become acquainted with the existence and location of all surface and subsurface structures within the project area. Contractor shall not damage any of those that are to remain and shall leave them accessible.
- B. The work shall be executed so that no damage or injury will occur to existing public and adjoining or adjacent structures, street, paving, or utilities. Should any damage or injury caused by the Contractor, or anyone in the Contractor's employ, or by the work under this contract occur, the Contractor shall, at his own expense, make good such damage and assume all responsibility for such injury.
- C. Monuments, bench marks, and other reference features on streets bounding this project shall be protected. Should these be disturbed in any manner, the Contractor shall have them replaced at own expense.
- D. Flag, barricade or suitably protect existing conditions during construction operations and equipment movement.
- E. Provide any other safety measures and follow any additional procedures requested by the West Point Department of Public Works or required by the United States Army Garrison Engineering Planning Standards.

2.5 DAMAGE

- A. Any damage to existing conditions by the Contractor or his subcontractors shall be immediately repaired with the least impact to the operation standards. If the repairs are not immediately addressed by the Contractor, the Owner will contract for the repair at the Contractor's expense.
- B. Post construction condition surveys shall be conducted by the Contractor. Any damage to the site shall be repaired to the condition identified in the preconstruction survey. The Engineer and/or Owner shall determine the acceptability of any repair.

END OF SECTION 020110

SECTION 02 08 00

ASBESTOS ABATEMENT

PART 1- GENERAL

1.01 SCOPE OF WORK

A. General

1. This Section specifies requirements for the removal and disposal of asbestos-containing materials (ACM) and/or asbestos-contaminated waste from the United States Military Academy Egner Hall Building located at 685 Hardee Place, West Point, New York 10996.
2. The abatement work shall be performed in accordance with Part 56 of Title 12 of the Official Compilation of Codes, Rules and Regulations of the State of New York (Cited as 12 NYCRR Part 56) and referenced documents specified in 1.02.
3. Remove all ACM as specified herein and Appendix "A" to this Section and as shown on the Contract Drawings. Transport and dispose asbestos-containing waste at a permitted landfill.

1.02 REFERENCES

The following is a listing of the publications referenced in this Section:

A. Federal Requirements

Federal Requirements which govern asbestos abatement work, hauling and disposal of asbestos include but are not necessarily limited to the following:

1. 29 CFR 1910.1101, "Asbestos" General Industry Standard (OSHA)
2. 29 CFR 1910.1200, "Hazard Communication" (OSHA)
3. 29 CFR 1910.134, "Respiratory Protection" (OSHA)
4. 29 CFR 1910.145, "Specification for Accident Prevention Signs and Tags" (OSHA)
6. 29 CFR 1926.1101, "Construction Industry" (OSHA)
7. 29 CFR 1926.500 "Fall Protection" (OSHA)
8. 29 CFR Part 1910.146 "Permit-Required Confined Spaces."
9. 29 CFR Part 1926.21 "Safety Training and Education"
10. 29 CFR Part 1926.32 "Definitions"
11. 29 CFR Part 1926.56 "Illumination"
12. 40 CFR 61, Subpart A, "General Provisions" (EPA)
13. 40 CFR 61, Subpart M, "National Emission Standard for Asbestos" (EPA)
14. 49 CFR 171-172, Transportation Standards (DOT)
15. 49 CFR Part 171.15 "Immediate Notice of Certain Hazardous Materials Incidents." (DOT)
16. 49 CFR Part 171.16 "Detailed Hazardous Materials Incidents Reports."

B. State Requirements

State requirements which govern asbestos abatement work and hauling and disposal of asbestos waste materials include but are not necessarily limited to the following:

1. 12 NYCRR, Part 56, "Asbestos", Industrial Code Rule 56 (DOL), amended 9/5/06

2. 6 NYCRR, Parts 360, 364, Disposal and Transportation (DEC)
3. 10 NYCRR, Part 73, "Asbestos Safety Program Requirements" (DOH)
4. Labor Law Article 32 "Licensing of Mold Inspection, Assessment and Remediation Specialists and Minimum Work Standards"

D. Local Requirements

Local agencies which may govern or have certain requirements regarding asbestos abatement work or hauling and disposal of asbestos waste materials include but are not necessarily limited to the following:

- a. West Point Building Department
- b. Fire Department (NYFD)
- c. Local Health Department

D. Standards

1. Contractor Responsibility: The Contractor shall assume full responsibility and liability for the compliance with all standards pertaining to work practices, hauling, disposal, and protection or workers, visitors to the site, and persons occupying areas adjacent to the site and all other requirements and responsibilities as dictated in Federal, State and local regulations and those specifications.
2. Standards which apply to asbestos abatement work or hauling and disposal of asbestos waste material include but are not necessarily limited to the following:
 - a. American National Standard Institute (ANSI) Z88.2-1992, Practices for Respiratory Protection
 - b. ANSI Z9.2-79, Fundamentals Governing the Design and Operation of Local Exhaust Systems
 - c. EPA 560/585-024, Guidance for Controlling Asbestos Containing Materials in Buildings (Purple Book)
 - d. EPA 530-SW-85-007, Asbestos Waste Management Guidance
 - e. American Society for Testing and Materials (ASTM), Safety and Health Requirements Relating to Occupational Exposure to Asbestos E 849-82.
 - f. Underwriter's Laboratories, Inc. (UL), Standards: 586 (High Efficiency Particulate Air filter units)
 - g. UL FR-S - UL Rating for Fire Retardant Wood
 - h. National Fire Protection Association (NFPA) 70 - National Electrical Code
 - i. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.03 REGULATORY COMPLIANCE

A. General

1. Work under this Section shall conform to the provisions of the following codes and regulations, except where otherwise specified herein or on the Contract Drawings.
 - a. 12 NYCRR, Part 56, ICR 56
 - b. 29 CFR Part 1926.1101
 - c. 40 CFR Part 61, Subparts A and M, EPA, NESHAP
 - d. NFPA 701
 - e. ANSI 88.2-1992.
 - f. Local Fire and Building Departments

2. All asbestos-containing waste is to be transported and disposed of in accordance with Federal requirements and State of New York Department of Transportation (DOT) regulations.
3. References in this Section to laws, codes, ordinances, regulations, standards or other federal, state, municipal, local or departmental legal requirements shall be deemed to mean the latest version or revision thereof or successor thereto, notwithstanding any change in numbering, designation or titles in effect at the time of Bid submission.

1.04 DEFINITIONS

The following general definitions are for terms that may be utilized or implied within this specification.

Abatement: Any portion of an asbestos project that includes procedures to control fiber release from asbestos containing material. This includes removal, encapsulation, enclosure, repair, or handling of asbestos material that may result in the release of asbestos fiber.

Accepted Methods/Methodologies: Procedures, regulations, or standards, which are published by recognized standards organizations (e.g. NIOSH, ASTM, ANSI), or are included within federal, state or local governmental regulations (e.g. OSHA, USEPA).

Active Project: A project becomes active when construction of the personal decontamination unit is required to be commenced, or when ACM, PACM or asbestos material is disturbed, whichever comes first, and is considered active until completion of Phase IID, unless, in response to a written request, permission is granted by the Department of Labor Engineering Services Unit to suspend the work on the project for a specified time period.

Additional Contractual Work: Additional asbestos abatement work not originally included within the NYS DOL asbestos project notification.

Adequately Wet: Sufficiently mix or penetrate a material with amended water to prevent the release of visible emissions. If visible emissions are observed coming from asbestos-containing material, then the material has not been adequately wetted.

Aggressive Air Sampling: An accepted method of sampling in which mechanical equipment is used before and during the sampling period to stir up settled dust/asbestos fibers.

Agricultural Building/Structure: A building/structure which is or was used exclusively for agricultural or horticultural activity. This definition does not include converted structures or buildings currently used for residential purposes or the processing or retail merchandising of agricultural or horticultural commodities.

Airlock: A system for permitting entrance and exit, while restricting air movement, between a contaminated area and an uncontaminated area.

Air Sampling: The process of measuring the fiber content of a known volume of air collected during a specific period of time, using accepted methodologies.

Ambient Air Sampling: A method of sampling by which an air sample is collected outside the regulated abatement work area, and is collected without the use of aggressive air sampling techniques.

Amended Water: Water to which a surfactant has been added.

Approved Asbestos Safety Training Program: A program, approved by the New York State Commissioner of Health, providing training in the various disciplines that may be involved in an asbestos project.

Asbestos: Any naturally occurring hydrated mineral silicate separable into commercially usable fibers, including chrysotile (serpentine), amosite, crocidolite, tremolite, anthophyllite and actinolite.

Asbestos Abatement Contractor: An asbestos contractor who performs abatement during an asbestos project or employs persons performing such abatement.

Asbestos Abatement Contractor Daily Project Log: A bound daily narrative journal maintained by the asbestos abatement contractor, which contains a synopsis of all pertinent events that occur throughout Phase II of the asbestos project.

Asbestos Containing Material (ACM): Any material containing greater than one percent (1%) of asbestos, also known as Asbestos Material.

Asbestos Contractor: The State, any political subdivision of the State, a public authority or any other governmental agency or instrumentality thereof, self-employed person, company, unincorporated association, firm, partnership or corporation and any owner or operator thereof, which engages in any portion of an asbestos project, or employs persons engaged in any portion of an asbestos project. (Exception: Property owners or prime contractors who hire asbestos contractors, but do not, themselves, direct or control the work.)

Asbestos Control Bureau: Asbestos Control Bureau, Division of Safety and Health, New York State Department of Labor.

Asbestos Handler (Worker): Any person who performs the duties described in Section NYCRR 56- (d) (1).

Asbestos Handling Certificate: A certificate issued by the Commissioner, New York State Department of Labor in any of the categories set forth in NYCRR 56-3.2(d).

Asbestos Handling License: A license issued by the Commissioner pursuant to Section 56-3.1 of 12 NYCRR 56 Subpart 2.

Asbestos Material: Any material containing greater than one percent (1%) of asbestos, also known as Asbestos Containing Material (ACM).

Asbestos Project: Work that involves the removal, encapsulation, enclosure, repair or disturbance of friable or non-friable asbestos, or any handling of asbestos material that may result in the release of asbestos fibers. Asbestos projects include Large asbestos projects, Small asbestos projects, Minor asbestos projects, incidental disturbance asbestos projects and emergency projects.

(i) Large asbestos project. An asbestos project involving the removal, disturbance, enclosure, encapsulation, repair or handling of 160 square feet or more of ACM, PACM or asbestos material or 260 linear feet or more of ACM, PACM or asbestos material.

(ii) Small asbestos project. An asbestos project involving the removal, encapsulation, enclosure, repair, disturbance or any handling of more than 10 and less than 160 square feet of ACM, PACM or asbestos material or more than 25 and less than 260 linear feet of ACM, PACM or asbestos material.

(iii) Minor asbestos project. An asbestos project involving the removal, disturbance, repair, encapsulation, enclosure or handling of 10 square feet or less of ACM, PACM or asbestos material, or 25 linear feet or less of ACM, PACM or asbestos material.

Asbestos Project Air Sampling Technician: An individual who performs the duties as described in ICR 56.

Asbestos Survey: A thorough inspection for and identification of all PACM, suspect ACM, or asbestos material throughout the building/structure or portion thereof to be demolished, renovated, remodeled, or repaired.

Asbestos Waste: ACM, PACM, asbestos material or asbestos contaminated objects requiring disposal pursuant to applicable laws or regulations. This includes RACM as well as Category I and II Non-Friable ACM.

Authorized Person" shall mean a person designated by the Owner in accordance with EPA NESHAP, 40 CFR Part 61, Section 61.145 (c)(8).

Background Air Sampling: A method used to determine airborne fiber concentrations in the area where abatement work is to be conducted, prior to starting Phase II A of the asbestos project.

Barriers: Critical Barriers and Isolation Barriers.

Building/Structure: A structure wholly or partially enclosed within exterior walls and a roof, intended to afford shelter to persons, animals or property; or a structure used as a conveyance for utilities, vehicular traffic or pedestrians (e.g. bridge, tunnel, manhole, subsurface conduits).

Building/Structure Owner: The State, any political subdivision of the State, a public authority or any other governmental agency or instrumentality thereof, person, company, unincorporated association, firm, partnership or corporation in whom legal title to the premises is vested unless the premises are held in land trust, in which instance building/structure owner means the person in whom beneficial title is vested.

Building/Structure Owner's Authorized Representative: A licensed asbestos contractor firm contractually responsible for execution of any building owner's responsibility, as required by this Part, during any phase of an asbestos project at the building owner's building/structure.

Bulk Sampling: Accepted methods for collecting samples of suspect materials for appropriate analyses by NYS ELAP approved laboratories, to determine asbestos content.

Category I Non-Friable ACM: NESHAP classification - Asbestos-containing packing, gaskets, resilient floor covering, and asphalt roofing products, containing more than one percent (1%) asbestos, that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Category II Non-Friable ACM: NESHAP classification - Any material, excluding Category I Non-Friable ACM, containing more than one percent (1%) asbestos, which when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Class I Asbestos Work: OSHA term meaning activities involving the abatement of Thermal Systems Insulation (TSI), and surfacing ACM and PACM.

Class II Asbestos Work: OSHA term meaning activities involving the abatement of ACM which is not TSI or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.

Class III Asbestos Work: OSHA term meaning Repair and Maintenance operations, where no more than a minor quantity of ACM, including TSI and surfacing ACM and PACM, is likely to be disturbed.

Class IV Asbestos Work: OSHA term meaning Maintenance and Custodial Activities during which employees contact but do not disturb ACM or PACM and activities to clean up non-ACM dust, waste and debris resulting from Class I, II and III activities.

Clean Room: An uncontaminated area or room, which is a part of the personal decontamination enclosure, with

provisions for storage and changing of persons' street clothes and protective equipment.

Cleanup: The utilization of HEPA-vacuuuming or wet cleaning or both to control and eliminate accumulations of asbestos material and asbestos waste material.

Clearance Air Sampling: An accepted method of air sampling used upon completion of final cleaning, during Phase IIC of an asbestos project. This method consists of using aggressive air sampling techniques to dislodge and stir up remaining asbestos fibers, then air samples are collected for appropriate analysis to determine representative airborne fiber concentrations.

Commissioner: The Commissioner of the New York State Department of Labor.

Containment: The negative-pressurized enclosure within the restricted area, which establishes the regulated abatement work area and surrounds the location where the asbestos abatement is actually taking place.

Critical Barrier: Barriers that seal off all openings to or within the defined regulated abatement work area, including but not limited to operable windows and skylights, doorways, ducts, grills, diffusers and any other penetrations to surfaces adjacent to or within the regulated abatement work area.

Curtained Doorway: An assembly which consists of at least three (3) overlapping sheets of 6-mil fire retardant plastic over an existing or temporarily framed doorway, used to separate the chambers within the decontamination system enclosures and to inhibit airflow if the negative air ventilation system shuts down.

Decontamination System Enclosure: A series of connected rooms, usually attached to the regulated abatement work area, for the decontamination of persons, materials and equipment.

Demolition: The wrecking or removal of any load-supporting structural member of a building or structure.

Department: The New York State Department of Labor.

Disturbance. Any activities that disrupt the matrix of ACM or PACM, or generate debris, visible emissions or airborne asbestos fibers from ACM or PACM. This includes moving of friable asbestos containing material from one place to another.

Emergency: An unexpected, unanticipated or unforeseen occurrence, including but not limited to, a steam, chemical, gas or water line rupture, a boiler failure, a building/structure collapse, or act of nature which may pose: (1) an imminent danger to the health and safety of the public; or (2) an asbestos-related risk to the health and safety of the public from release of asbestos fibers.

"Emergency Exit" or "Egress" shall mean an area within the Work Area (e.g., door or kick-out panel) that may be opened or broken for the immediate egress of people from the Work Area in case of an emergency.

Emergency Asbestos Project: An asbestos project which is necessary to respond to an emergency.

Encapsulant (Sealant) or Encapsulating Agent: A liquid material, which can be applied to asbestos material and which prevents the release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together and to the substrate (penetrating encapsulant).

Encapsulation: Abatement consisting of the coating or spraying of asbestos material with an encapsulant (sealant) or encapsulating agent.

Enclosure: Abatement consisting of the construction of airtight walls, ceilings and floors between the asbestos

material and the building/structure environment, or around surfaces coated with asbestos material, or any other appropriate procedure as determined by the Department, which prevents the release of asbestos fibers.

Environmental Consultant - An "Environmental Consultant" means a Consulting Firm or its employee retained by the Agency to overlook this project and perform project monitoring and air sampling.

EPA: The United States Environmental Protection Agency.

Equipment Room: A contained area or room which is part of the personal decontamination system enclosure with provisions for the storage of contaminated clothing and equipment.

Fiber (Asbestos Fiber): Generally, a slender or elongated structure, which results from the breakup of ACM, PACM or asbestos material. However, the definition of an asbestos fiber is also dependent upon the approved accepted method of air sampling and analysis utilized for the specific phase of the asbestos project.

"Fire Safety" shall mean that the entity performing Work of this Section shall be responsible for compliance with FDNY FC 1408 for Work in New York State.

Fixed Object: Equipment, furniture or other item that is affixed, as a whole, to a floor, ceiling, wall or other building structure or system.

Friable: Any material that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure, or is capable of being released into the air by hand pressure.

Glovebag: A manufactured impervious bag-like enclosure constructed of at least six (6) mil transparent plastic, seamless at the bottom, with inward-projecting long sleeve glove(s), which may also contain an inward-projecting water-wand sleeve, an internal tool pouch, and an attached, labeled receptacle or portion for asbestos waste. The glovebag is constructed and installed to surround the object or area to be decontaminated and contain all asbestos fibers released during the abatement process.

Glovebag Technique: A method for removing asbestos material from heating, ventilating, and air conditioning (HVAC) ducts, piping runs, valves, joints and elbows, and other non-planar surfaces, by use of a glovebag.

Glue: A material used as an adhesive, such as the material used to hold tiles to a surface. See Mastic. 12 NYCRR 56 Subpart 2, Page 13

HEPA-Filter: A high efficiency particulate air filter capable of trapping and retaining 99.97 percent of all mono-dispersed particles of 0.3 microns in diameter or larger.

HEPA-Vacuum Equipment: Vacuuming equipment designed for abatement, with a high efficiency particulate air filtration system.

Holding Area: A chamber in the waste decontamination enclosure utilized for temporary storage of containerized ACM waste, prior to transfer to waste transport vehicle.

Incidental Disturbance: The unintentional disturbance of, ACM, PACM, or asbestos material.

Incidental Disturbance Asbestos Project: The cleanup, repair or encapsulation of less than 10 square feet or less than 25 linear feet of incidentally disturbed ACM, PACM or asbestos material.

"Initial Exposure Assessment" and "Negative Initial Exposure Assessment" are terms defined in the OSHA construction standards.

Inspector: Any person who performs the duties described at Section 56-3.2(d)(4) of this Part.

Intact: Asbestos material that has not crumbled, been pulverized, or otherwise been damaged or disturbed, and the material's matrix has not noticeably deteriorated.

Intermediate Portions of a Project: The discrete abatement segments that will take place where non-continuous interim notifications are required, as per Section 56-3.4(b)(4)(v), for large asbestos projects

Isolation Barriers: Installed temporary hardwall barriers that complete the containment enclosure and establish the regulated abatement work area.

Lockdown Encapsulant: A thinned out bridging encapsulant used for lockdown purposes to assist with cleanup as per this Part.

Management Planner: Any person who performs the duties described at Section 56-3.2 (d) (9) of this Part.

Mastic. A pasty material used as an adhesive.

Mounted Object: Equipment, furniture, or other item that is attached, in whole or in part, to a floor, ceiling, wall or other building structure or system or to a fixed object.

Movable Object: Equipment, furniture or other item that is not attached or affixed, in whole or in part, to a floor, ceiling, wall or other building structure or system or to a fixed object. 12 NYCRR 56 Subpart 2, Page 14

Multi-employer Work Sites: Any demolition, renovation, remodeling or repair project work site, which includes work covered by this part, where more than one employer is reasonably expected to be on-site during the project.

Multiple Abatement: The abatement of more than one type of ACM within the same containment.

Negative Air Pressure Equipment: A local exhaust system, capable of maintaining air pressure within a containment at a lower pressure than the air pressure outside of such containment, and which provides for HEPA filtration of all air exhausted from the containment.

NESHAP: National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61).

NIOSH: The National Institute for Occupational Safety and Health.

Non-Asbestos Material: Any material documented to contain one percent (1%) or less of asbestos.

Non-Friable: Any material that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure, and is not capable of being released into the air by hand pressure.

Non-Friable Organically Bound (NOB) Asbestos Material: Non-friable asbestos materials embedded in flexible-to-rigid asphalt or vinyl matrices, including but not limited to flooring materials, adhesives, mastics, asphalt shingles, roofing materials and caulks.

Occupied Area: Any frequented portion of the work site where abatement is not taking place.

Operations and Maintenance Worker: Any person who performs the duties described at Section 56-3.2 (d) (5) of this Part.

OSHA: The Occupational Safety and Health Administration.

Outside Air: The air immediately outside the building or structure in which an asbestos project is performed.

Personal Air Sampling: Air sampling located in a worker's breathing zone.

Personal Decontamination System Enclosure: An area designated for controlled passage of all persons to and from the regulated abatement work area. 12 NYCRR 56 Subpart 2, Page 15

Personal Protective Equipment (PPE): Disposable work suits or coveralls, head covering, eye protection, footwear, gloves and appropriate NIOSH approved respirators with appropriate NIOSH-approved filters.

Plasticize: To cover floors, walls, ceilings or other surfaces with 6-mil fire retardant plastic sheeting.

Presumed Asbestos Containing Material (PACM): All Thermal System Insulations and Surfacing Materials found in buildings constructed no later than 1980. PACM is considered to be ACM unless proven otherwise by appropriate bulk sampling and laboratory analyses.

Project Air Sampling: Area air sampling conducted in accordance with ICR 56-4 during the course of the asbestos project.

Certified Project Designer: Any person who performs the duties described in ICR 56-3.2(d)(7).

Project Monitor: Any person who performs the duties described in ICR 56-3.2(d)(8).

Receptor: Any opening, which could admit asbestos fibers into a structure if not properly protected. Examples include but are not limited to operable windows, doors, vents, air intakes or exhausts of any mechanical device within a building or structure.

Regulated Abatement Work Area: The portion of the restricted area where abatement work actually occurs. For tent work areas, the interior of each tent is a regulated abatement work area. For OSHA Class I and Class II asbestos abatement, the interior of the restricted area containment enclosure is the regulated abatement work area. For exterior non-friable asbestos abatement conducted without the establishment of negative air ventilation systems or containment enclosures, the entire restricted area surrounding the abatement location is considered to be the regulated abatement work area.

Regulated Asbestos-Containing Material (RACM): Friable ACM or PACM, Category I Non-friable ACM that has become friable or has been or will be subjected to sanding, grinding, cutting or abrading, or Category II Non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations.

Remodel: For purposes of this code, remodel shall mean the same as renovation.

Remote Decontamination System Enclosure: Decontamination systems that are not attached to the regulated abatement work area but are within the work site.

Removal: Abatement, consisting of operations where ACM, PACM or asbestos material is removed or stripped from structures or substrates. This includes demolition operations.

Renovation: The altering of an existing building/structure, or a portion of building/structure components or systems, including the stripping, removal or abatement of ACM from a building or structure. Operations in which load supporting structural members are wrecked or taken out are demolitions.

Repair (Asbestos): Abatement, consisting of corrective action for a Minor Asbestos Project using required work practices to control fiber release from damaged ACM, PACM or asbestos material.

Repair: The replacement, overhaul, rebuilding, reconstructing or reconditioning of any part of a building/structure component or system with like or similar material or parts, due to damage or excessive wear.

Respiratory Protection: NIOSH-approved respirators with appropriate NIOSH approved filters.

Restricted Area: A restricted area established and marked for the abatement portion of an asbestos project. This area shall include, but not be limited to asbestos project regulated abatement work areas and any contiguous decontamination facilities, adjoining staging areas where work materials, debris or waste from such work may accumulate, remote decontamination areas, and waste storage areas (dumpsters, trailers, etc.).

Sealant: An encapsulating agent. A material which can be applied to asbestos containing material which prevents the release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant) or by penetrating into the material and binding its components together and to the substrate (penetrating encapsulant).

Sequential Abatement: The abatement of different types of asbestos containing material within a common regulated abatement work area in a priority order.

Shower Room: A room between the clean room and the equipment room in the personal decontamination enclosure with hot and cold running water controllable at the tap and arranged for complete showering during decontamination.

Supervisor: Any person who performs the duties described in ICR Section 56-3.2(d) (6).

Suspect Miscellaneous ACM: Any suspect asbestos-containing material that is not PACM, such as floor tiles, ceiling tiles, mastics/adhesives, sealants, roofing materials, cementitious materials, etc. All suspect miscellaneous ACM must be assumed to be ACM, unless proven otherwise by appropriate bulk sampling and laboratory analyses.

Surfacing Material: Material that is sprayed-on, troweled-on, or otherwise applied to surfaces (such as acoustical or finish plaster on ceilings and walls, and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes).

Surfactant: A chemical wetting agent added to water to reduce the surface tension of the water and improve its penetration for added mitigation of airborne fiber release.

"Support Structures" shall mean any temporary structure constructed to perform Work of this Section, including Work Area isolation barriers built outdoors and passage tunnels within twenty-five feet from the perimeter of the "Work Area" required by ICR 56.

Tent: A fire retardant polyethylene enclosure that includes walls, ceiling and a floor as required to remove ACM, PACM or asbestos material.

Thermal System Insulation: Insulation material applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat gain or loss.

Variance (Site-specific): Relief in accordance with Section 30 of the Labor Law from specific sections of Industrial Code Rule 56 for a specific project.

Variance (Applicable) (AV): Blanket relief in accordance with Section 30 of the Labor Law from specific sections of Industrial Code Rule 56 for a particular type of project.

Visible Emission: Any emission of particulate material that can be seen without the aid of instruments.

Washroom: A room between the regulated abatement work area and the holding area in the waste decontamination system enclosure, where equipment and waste containers are wet cleaned or HEPA-vacuumed.

Waste Decontamination System Enclosure: An area, consisting of a washroom and a holding area separated from each other by airlocks, designated for the controlled transfer of materials and equipment from the regulated abatement work area.

Waste Staging Area: The area near the waste transfer airlock where containerized asbestos waste has been placed prior to removal from the regulated abatement work area.

Wet Cleaning: The process of eliminating asbestos contamination from surfaces, equipment or other objects by using cloths, mops, or other cleaning tools that have been saturated with amended water.

Work Site: Building, structure, parcel of land or premises where an asbestos project takes place.

1.05 QUALITY ASSURANCE

A. Qualifications

1. The entity performing Work of this Section shall:
 - a. Possess valid licenses, permits and certificates for the state in which the Work is performed.
 - b. Employ a "Certified Asbestos Project Designers" with a minimum of three years of experience on projects with a similar scope, asbestos abatement handlers, restricted handlers, and asbestos abatement supervisors with a minimum of three years of experience on projects with a similar scope, who possess valid certifications and licenses for the state in which Work is performed.
 - c. Provide at the "Work Area" a "Competent Person", which shall mean a person who conforms to 29 CFR 1926.32 (f), 1926.1101 (b), 40 CFR 61 Subpart M. In addition, such person shall have at least three years of experience on asbestos abatement projects as an asbestos abatement supervisor in the state in which Work of this Section is performed.
 - d. Employ an environmental laboratory, that conforms to the Quality Control Procedures of 29 CFR 1926.1101 Appendix A, participates in a national sampling testing scheme such as the Proficiency Analytical Testing Program (PAT) or the Asbestos Registry sponsored by the American Industrial Hygiene Association (AIHA).
2. The landfill disposal site for the asbestos-containing materials and/or asbestos contaminated objects shall be a site or a facility with valid municipal, state, federal permits (where applicable).

1.06 WORK AREA CONDITIONS

- ##### A. The Owner will retain and Environmental Consultant to perform project monitoring including air sampling and analysis of samples. The Environmental Consultant will provide analytical results of such air monitoring to the Contractor for use by the entity performing Work of this Section:
1. Baseline sample results collected within and adjacent to the "Work Area(s)" during normal occupancy conditions prior to the commencement of asbestos abatement activities.
 2. For Work of this Section performed in New York State, pre-abatement (area preparation) sample results collected within and adjacent to the "Work Area(s)" during asbestos abatement preparation activities.
 3. Sample results taken outside the "Work Area(s)" during abatement activities.
 - a. If during the performance of abatement Work, air sample results taken outside the "Work Area" exceed normal occupancy baseline levels or fiber concentration levels in air are at or

in excess of 0.01 fibers per cubic centimeter (whichever is greater), the entity performing Work of this Section shall take appropriate corrective action until acceptable levels are achieved, as determined solely by the Environmental Consultant.

4. Post-abatement air clearance samples and analysis.
- B. The entity performing Work of this Section shall:
1. Perform initial employee exposure air monitoring in accordance with 29 CFR 1926.1101 (f)(2).
 2. Perform full shift daily monitoring for a minimum of 20 percent of the workers performing a task within the "Work Area" each working shift in accordance with 29 CFR 1926.1101 (f)(3).
 3. Throughout Work of this Section, ensure that the competent person/site supervisor reviews all air monitoring reports. Based upon employee exposure monitoring and analysis of airborne fiber concentration levels, the competent person/asbestos supervisor shall determine the required level of respiratory protection established in accordance with 29 CFR 1926.1101(h).
 - a. If based upon the results of employee exposure air monitoring the entity performing Work of this Section requests that monitoring be suspended in accordance with 29 CFR 1926.1101 (f)(4), the CIH shall determine if full shift monitoring accurately represented the airborne exposure to asbestos for the Work of this Section, and shall prepare a written recommendation with reasons why monitoring may be suspended. Submit the recommendation to the Environmental Consultant for approval.
 - b. Report results of employee exposure air monitoring analyses to the Environmental Consultant not more than 24 hours after the collection of the sample, and post written laboratory results within two calendar days.
 4. For post-abatement air clearance sampling provide, install, maintain and operate aggressive forced air equipment, e.g., fans and leaf blowers, in accordance with the requirements of the state in which Work is performed.
 5. Perform re-cleaning, if the "Work Area" fails the post-abatement air clearance test.
 6. Ensure that the "Competent Person" attends all meetings related to Work of this Section.
- C. Unless otherwise stipulated in Appendix "A" to this Section or shown on the Contract Drawings, utilities and systems, such as water, gas, sewers, electricity, steam heating, cooling ventilation, elevators, fire protection systems, sprinklers and smoke detectors, passing through the "Work Area(s)", shall continue to service areas outside of the "Work Area(s)". Where stipulated in Appendix "A" to this Section, or shown on the Contract Drawings, shut down and lockout utilities and systems as necessary to perform Work of this Section. The entity performing Work of this Section shall coordinate with the Environmental Consultant prior to interrupting, re-routing or otherwise affecting any operating system or utility. The Owner will perform, and the Environmental Consultant will provide certification of, utility and system shutdown(s), lockouts, and required pressurization of ventilation duct systems. Notify the Environmental Consultant prior to the deactivation of "Work Area(s)" and/or "Work Site" fire protection system(s).

1.07 SUBMITTALS

Submit the following in accordance with the requirements of "Shop Drawings, Catalog Cuts and Samples" of the GENERAL PROVISIONS:

- A. Shop Drawings
1. Detailed site-specific drawings prepared and signed by a Certified Project Designer" which shall include, the following:
 - a. Negative Air Unit calculations.

- b. Engineering controls (e.g., work area enclosure; decontamination unit(s) layout and location; work area boundaries).
 - c. Abatement Work procedures.
 - d. Emergency egress location(s).
 - e. Requirements for electric power, water supply and drainage.
 - f. Requirements for storage and staging location(s).
- 2. Support Structures: Drawings, design details and calculations for temporary "Support Structure(s)", signed and sealed by a Professional Engineer (P.E.) licensed in the state in which Work of this Section is performed. Following installation of "Support Structure(s)", submit P.E. signed inspection report verifying compliance with design; for "Work Area" isolation barriers built outdoors, include anchoring details; for passage tunnels required by ICR 56-11.6, include anchoring and lighting details.
- 3. List of all materials and equipment to be used for Work of this Section.
- B. Catalog Cuts
 - 1. Catalog cuts for all materials and equipment to be used for Work of this Section.
- C. Product Data
 - 1. Safety Data Sheets and a copy of the product labels for all chemicals to be used for Work of this Section.
- D. Construction and Installation Procedures
 - 1. "Work Area" and "Work Site" procedures.
 - 2. Fire Prevention, First aid procedures and Pre-fire plan.
 - 3. "Work Site" communications with police, fire department, facility operations and the Engineer.
- E. Qualifications
 - 1. Copy of valid Asbestos Contractor's License.
 - 2. Information on the "Competent Person" (e.g., resume) showing three years project supervision experience.
 - 3. Copy of valid Asbestos Abatement Supervisor Certificate.
 - 4. Copies of Asbestos Handler Certificates for the workers.
 - 5. Information (e.g., resume) on the "Certified Project Designer" the Contractor plans to use, in accordance with 1.05 A.1.b of this Section, and copy of valid Asbestos Project Designer Certificate.
 - 6. Information (e.g., resume) on the Certified Industrial Hygienist (CIH) the Contractor plans to use, in accordance with 1.05 A.1.d of this Section, and copy of valid American Board Industrial Hygiene (ABIH) Certificate.
 - 7. Information on the environmental laboratory the Contractor plans to use, including proof of participation in the American Industrial Hygiene Association's (AIHA) Proficiency Analytical Testing Program (PAT) or the Asbestos Registry sponsored by the American Industrial Hygiene Association.
 - 8. List of subcontractors Contractor plans to use. Submit their appropriate qualifications in accordance with 1.05 of this Section.
 - 9. Name of asbestos waste transporter the Contractor plans to use. Provide documentation showing, for each state in which transportation is to occur, the following:
 - a. Copies of transporter's permits, licenses and/or certificates as required by state agencies to operate.

- b. Name, title and phone number of transporter's contact person.
 - c. DOT statement of reportable accidents and reportable environmental incidents in accordance with 49 CFR 171.15 and 49 CFR 171.16.
- F. Quality Assurance-Quality Control
 - 1. Outline of respiratory protection program for employees conforming to current regulations. The outline shall bear the signature and approval of a CIH.
 - 2. Copies of notifications and re-notifications.
 - 3. Copies of project-specific variances obtained by the Contractor for Work of this Section.
- G. Contact Information
 - 1. Project Specific Chain of Command: Include on Chain of Command form(s) office, mobile and home telephone numbers of persons having the authority to dispatch personnel to the "Work Site" location and to commit such persons to the tasks as directed by the Building Engineer. At a minimum include numbers for the asbestos abatement supervisor, the "Competent Person" and the CIH.
- H. Preliminary Schedule:
 - 1. Provide an estimate of manpower to be utilized and the time required for completion of each major Work Area. Include estimated work shifts and crew size anticipated to complete the project.
 - 2. Provide detailed work schedule including dates, work shift time, number of employees, dates of start and completion including dates of preparation work, removal and final inspection dates.
- I. Other Items:
 - 1. Certificate of insurance covering work of this Contract.
 - 2. Name, location, and applicable licenses for primary and secondary landfill for disposal of asbestos-containing material and asbestos contaminated waste.
 - 3. Certification that each on-site employee has been properly fit tested with a NIOSH Approved respirator within the past 6 months.
 - 4. If rental equipment is to be used in work area or to transport asbestos contaminated waste, provide notice to rental agency stating intended use of equipment, with copy to the Owner.
 - 5. Summary of the Contractor's workforce by disciplines. Include a notarized statement signed by the Contractor documenting that all proposed workers, by name, have received all required medical examinations and have been properly trained and certified in asbestos removal work, respirator use, to appropriate EPA and OSHA standards for asbestos removal. Include on statement Contractor's compliance with OSHA medical surveillance requirements.

1.08 INDEMNIFICATION

- A. The Contractor and its sub-contractors shall indemnify and hold harmless the Owner and the Environmental Consultant, and their directors, officers, agents, employees and consultants from and against all claims, damages, losses, liabilities and expenses, out of or resulting from the performance of the work specified herein.
- B. Nothing in these specifications shall be inferred to transfer the Contractor's responsibility for a thorough and safe job to the Owner or the Environmental Consultant.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. All products, equipment and material used by the Contractor shall be of sufficient size, configuration and quality to perform the tasks required.
- B. Ensure that the entity performing Work of this Section provides, maintains and uses equipment necessary to complete the Work of this Section, including at a minimum the following:
 - 1. Respirators selected by the CIH based upon airborne fiber concentrations determined in accordance with 1.06 B herein.
 - 2. Daily employee exposure air monitoring equipment for not less than 20 percent of workers employed in each task during each work shift in accordance with 1.06 B herein.
 - 3. Protective clothing and equipment for personnel exposed to airborne concentration levels of asbestos fibers including, but not limited to, whole body disposable covering, gloves, head covering, foot covering, hardhats and eye protection.
 - 4. Stocked first aid kits in the clean room of the decontamination unit and in the "Work Area" including, but not limited to, bandages, antiseptic wipes, burn cream, eye flushing solution and tourniquets.
 - 5. Twenty-pound A-B-C multipurpose dry chemical fire extinguishers located in the clean and equipment rooms of the decontamination unit(s) emergency egress locations and the "Work Area".
 - 6. Negative pressure air filtration equipment.
 - 7. Continuous chart recording manometers to measure differential air pressure.
 - 8. Aggressive forced air equipment, e.g., leaf blowers and fans, for use during post- abatement air clearance sampling.
 - 9. Fully enclosed and lockable waste dumpsters, trailers, or roll-offs, with the interior walls and floors lined with one layer of 6-mil fire-retardant polyethylene.
 - 10. Asbestos warning signs, leak-tight containers and transportation labels, all conforming to 29 CFR 1926.1101(k), and 40 CFR Part 61, Section 61.150.
 - 11. Spare containers and labels at the "Work Site", and on the waste transport vehicle for use in case of accidental loss or breakage.
 - 12. HEPA vacuums, rubber or plastic dustpans, squeegees or non-metallic shovels with rounded edges, hand tools, OSHA approved ladders and scaffolds, and inclined chutes where required for Work at heights 10 feet or greater above the floor or adjacent ground surface.
 - 13. Temporary electric panel equipped with ground fault circuit interrupters conforming to NYCEC. Provide temporary lighting within the "Work Area" at a minimum level conforming to 29 CFR 1926.56, Illumination.
 - 14. Battery operated emergency lighting within the "Work Area", personnel and waste decontamination unit(s) and emergency egress locations. Self-luminous emergency fire exit and directional signs identifying the path to, and location of decontamination units, and emergency egress locations.

2.02 MATERIALS

- A. Ensure that the entity performing Work of this Section provides, maintains and uses materials necessary to complete the Work of this Section, including at a minimum the following:

1. Leak-tight containment waste bags of clear or colored plastic, at least 6-mil in thickness, with approved warning and transportation labels.
2. Commercially available glove bags of at least 6-mil transparent polyethylene with approved asbestos warning labels.
3. Surfactant, lock-down sealant, and encapsulating products recommended by the respective product manufacturers for the specific type of asbestos being abated, and as approved by the Environmental Consultant.
4. Lumber having an Underwriters Laboratories (UL) rating of FR-S. Lumber for temporary support structures shall be UL rated FR-S.
5. Minimum 6-mil polyethylene and reinforced polyethylene, with a fire-retardant rating conforming to NFPA Standard 701.
6. Miscellaneous materials, such as water-resistant duct tape, adhesives, caulking, nails, fasteners and hardware, as required to perform the Work of this Section.

2.03 PERSONNEL PROTECTION

1. Coveralls: Provide disposable full-body coveralls and disposable head covers, and require that they be worn by all workers in the work area. Provide a sufficient number for all required changes, for all workers in the work area and also for authorized visitors.
2. Boots: Provide work boots with non-skid soles, and where required by OSHA, foot protection, for all workers. Do not remove asbestos contaminated boots from the work area. Dispose of boots as ACW at the end of the work or seal in 6-mil poly bags (with labels) for transportation to another work area.
3. Goggles: Provide protection goggles as required by OSHA for all workers involved in scraping, spraying, or any other activity which may potentially cause eye injury. Goggles are not required if full-face respiratory protection is used.
4. Gloves: Provide work gloves to all workers and require that they be worn at all times in the work area. Do not remove gloves from work area and dispose of as ACW at the end of the work.
5. Hard Hats: Provide hard hats to all workers and authorized visitors and require that they be worn at all times in the Work Area. Hard hats shall be worn over the hood of the coveralls.

2.04. RESPIRATORY PROTECTION

- A. Respiratory protection shall be worn by all individuals inside the work area from the initiation of the asbestos project until all areas have successfully passed final air clearance monitoring in accordance. All individuals shall be medically fit to wear the respirator.
- B. The Contractor shall provide at a minimum a half or full face air purifying respirators with HEPA filters shall be worn only during the preparation of the work area, performance of repairs (e.g. using glove-bag techniques) and final clean-up procedures provided airborne fiber concentrations inside the work area are less than stated criteria for each mask type. Full face respirators are allowed for airborne fiber concentrations up to 5 f/cc; half mask respirators are allowed for airborne fiber concentrations up to 1 f/cc.
- C. Workers shall be provided with personally issued and individually marked respirators. Respirators shall not be marked with any equipment that will alter the fit of the respirator in any way. Only waterproof identification markers shall be used.

2.05 TEMPORARY FACILITIES

- A. Locate temporary services and facilities where they will serve the work area adequately and result in minimum interference with the performance of the work. Relocate, modify, and extend services and facilities as required during the course of work so as to accommodate the work of this Contract.
 - 1. Provide materials and equipment that are undamaged and in serviceable condition and provide only materials and equipment that are recognized as being suitable for the intended use, by compliance with appropriate standards.
 - 2. Provide all scaffolding, ladders and/or staging, etc. as necessary to accomplish the work of this contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of all scaffolding shall comply with all applicable OSHA provisions. Equip rungs of all metal ladders, etc. with an abrasive non-slip surface. Provide a nonskid surface on all scaffold surfaces subject to foot traffic.
 - 3. All ladders must be constructed of a material capable of being decontaminated. Damaged ladders or ladders constructed of wood or conductive metals will not be allowed in the work areas.
- B. Water Service
 - 1. The contractor shall provide the temporary Water Service Connection. All connections to water systems shall include backflow protection. Employ heavy-duty abrasion-resistant hoses with pressure ratings greater than the maximum pressure of the water distribution system to provide water into each work area and to each Decontamination Unit. If hot water is not available from the building, the Contractor shall arrange for water heaters at no extra cost to the Owner.
- C. Electrical Service
 - 1. Comply with applicable NEMA, NECA and UL standards and governing regulations and codes for materials and layout of temporary electric service. Provide a weatherproof, grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of work during the construction period. Install temporary lighting adequate to provide sufficient illumination for safe work and traffic conditions in every area of work.
 - 2. Temporary Electrical Panel: Provide temporary GFCI electrical panel sized and equipped to accommodate all electrical equipment and lighting required by the work.
 - 3. First Aid Supplies
- D. Fire Extinguisher
 - 1. Provide Type "A" fire extinguisher for temporary offices and similar spaces where there is minimal danger of electrical or grease-oil-flammable liquid fires. In other locations provide type "ABC" dry chemical extinguisher, or a combination of several extinguisher, or a combination of several extinguisher of NFPA recommended types for the exposures in each case.
- E. Scaffolding
 - 1. The Contractor shall provide all scaffolding, ladder and/or staging as necessary to accomplish the work of this contract. The erection and use of all scaffolding shall comply with OSHA 29 CFR 1926 and other applicable codes. The installation of scaffolding must be inspected by competent and qualified personnel. During the erection and/or moving of the asbestos removal Contractor's scaffolding, care

must be exercised so that the polyethylene floor covering is not damaged. Clean debris from non-slip surfaces as necessary.

F. Installation

1. Use qualified and licensed tradesmen for installation of temporary services and facilities. Locate temporary services and facilities where they will serve the entire project adequately and result in minimum interference with the performance of the work.

G. Tools and Equipment

1. Shovels used must be constructed of plastic or rubber. Nylon bristle brushes may be used for cleaning. Under no circumstances will steel bristle brushes be allowed.

H. Emergency Lighting, Lighting, Alarms and Fire Safety

1. The contractor will not act to interfere with the operations of existing fire protection devices at the site in any way, unless specifically called for in these specifications. Inside the containment, provide services for emergency lighting in case of power failure.

I. Other Air Sampling Supplies

The Contractor shall provide Power inside and outside the work area for air sampling including extension cords and GFCI's. The sampling will be performed by the Owner's Environmental Consultant.

PART 3 - EXECUTION

3.01 PRE-ASBESTOS WORK SITE PREPARATION

- A. The following items shall be performed by the Contractor at all "Work Area(s)" and the "Work Site":
1. Post the EPA notification letter, and if applicable, all re-notifications.
 2. Post bulk sampling results.
 3. As required, isolate, shutdown, pressurize, de-energize and lockout utilities and services listed in Appendix "A" to this Section.
 4. Inspect and evaluate waste container(s) upon arrival at the "Work Site". Damaged, improperly sealing or locking waste container(s) will be rejected.
 5. Place locks on all waste containers.
 6. Field verify the engineering controls.
- B. If Appendix "A" to this Section stipulates that a "Work Area" is a Confined Space as defined by 29 CFR 1926.21(b)(6)(ii) and 29 CFR 1910.146, ensure that the entity performing Work of this Section takes responsibility for and takes the appropriate safety measures stipulated therein.
- C. Ensure that the entity performing Work of this Section sends a notification letter, a minimum of 10 days prior to the start of Work of this Section to the building occupants who may be impacted by Work of this Section.
1. Ensure that the entity performing Work of this Section posts the "Notice of Abatement Project" signs, 10 days prior to the start of Work; at locations determined by the Building Engineer.
- D. Ensure that the entity performing Work of Section posts the following items on a notification board located at the entrance to the clean room of the decontamination unit:
1. Copy of the abatement Contractor's License from the state.

2. Copies of the certifications of air-sampling technician, project monitor, supervisor and handlers.
 3. OSHA air monitoring results (within 48 hours of sample collection).
 4. Emergency first aid procedures and notification telephone numbers.
 5. If applicable, air compressor operator certificates of approval or fitness.
 6. Name of the "Work Site" "Competent Person", and a list of names of workers who are authorized to enter the "Work Area(s)".
 7. Chain-of-command and telephone numbers.
 8. Copies of all required city and state asbestos waste transporter licenses, certificates and permits.
 9. Signs as required by 29 CFR 1926.1101(k) at all entrances to the "Work Area".
 10. Copy of this Specification Section, including Appendices.
 11. Copy of approved applicable, or project-specific, state variances pertinent to the Work.
 12. Laboratory results of OSHA air monitoring samples as specified in 1.06 B.3.b herein.
- E. Ensure that the following items shall be available at the "Work site" by the entity performing Work of this Section for inspection:
1. The Contract booklet and Contract Drawings and in addition, a copy of all approved submitted drawings and procedures.
 2. Copies of regulations specified herein.
 3. Safety Data Sheets (SDSs).
 4. NESHAP asbestos generator shipping labels.
 5. The record of all manometer recordings.
 6. Laboratory results for OSHA air monitoring samples.

3.02 WORK AREA PREPARATION

- A. Work of this Section at the "Work Area" or the "Work Site" shall not commence until all asbestos removal and disposal submittals are approved.
- B. Work of this Section at the "Work Area" shall proceed only when the "Competent Person" and Owner's "Authorized Person" are present at the "Work Area".
- C. If the scheduled starting date cannot be met, ensure that the entity performing Work of this Section requests a start date change in writing to the Building Engineer at least 72 hours before the initial notice start date. Schedule changes are subject to the approval of the Building Engineer. Regulatory re-notifications shall be performed by the entity performing Work of this Section.
- D. Notify the Building Engineer of staging procedures and shift schedules not less than 48 hours in advance. Such shift changes shall be subject to the approval of the Building Engineer.
- E. Ensure that the entity performing Work of this Section performs the following in accordance with the Contract Drawings:
 1. After utility shutdown in accordance with 1.06 C herein, remove filters from the HVAC system, double bag, store and dispose of as asbestos-contaminated waste. Seal all openings in the HVAC and other utility systems within the "Work Area(s)" with at least two layers of 6-mil fire-retardant polyethylene sheeting.
 2. Prior to the construction of the decontamination unit(s), remove asbestos that may be disturbed by such installation utilizing an approved isolation tent removal procedure to remove a one-foot wide strip at the locations where asbestos may be disturbed.
 3. Pre-clean the location where the decontamination enclosure(s) will be constructed using HEPA vacuuming and/or wet cleaning.

4. Construct the decontamination unit(s) in accordance with the Contract Drawings, and the Contractor's approved submittals.
 5. Pre-clean the "Work Area" using HEPA vacuuming or wet cleaning methods, or a combination of methods.
 6. Establish the "Isolation Barrier Partitions", "Critical Barriers", "Surface Barriers", or demarcate an area, and seal all openings. Stationary equipment within the "Work Area(s)" shall be enclosed, protected and ventilated, as required in accordance with the Contract Drawings.
 7. Pre-clean fixed objects within the "Work Area(s)" and enclose objects to remain, in accordance with the Contract Drawings. Pre-clean movable items before removal from the "Work Area" in accordance with the Contract Drawings.
 8. Paint, or apply tape, in a fluorescent color at the fire extinguisher locations, door frames of the decontamination unit(s), emergency egress locations, kick-out panels and along wall bases showing direction towards the nearest exit.
 9. Install and continuously operate the negative air filtration system in accordance with the Contract Drawings.
 10. Floor, Wall & Ceiling Plasticizing and Sealing. All porous floor, wall and ceiling surfaces, except where abatement of ACM, PACM or asbestos material shall be performed on those specific surfaces, shall be covered with one (1) layer of, at a minimum, six (6) mil fire-retardant plastic sheeting. The floor shall be plasticized first, and its plastic sheeting shall extend up the walls a distance of at least twelve (12) inches on all sides. The walls shall then be plasticized by applying plastic sheeting from the ceiling to the floor, overlapping the floor sheeting by at least twelve (12) inches. Next, the ceiling shall be plasticized, overlapping the walls by at least twelve (12) inches, to form a secure airtight seam. If the floor surface is not to be plasticized, it shall be made watertight. All seams in the plastic shall be sealed watertight and airtight.
 11. Suspended Ceilings. Suspended ceiling tiles and T-grid components in proximity to friable ACM shall remain in place until the regulated abatement work area has been fully prepared in accordance with this Section, and electrical and HVAC systems have been shut down. These potentially contaminated suspended ceiling components shall be removed at the completion of the remaining work area preparation, including establishment of negative air ventilation systems. These removed ceiling components shall be bagged/containerized and disposed of as asbestos waste.
- F. Notify the Environmental Consultant in writing that asbestos removal is ready to commence within 24 hours after such notification by the Contractor, a pre-removal inspection will be performed by the Environmental Consultant. After a successful pre-removal inspection and approval of the Environmental Consultant, commence with asbestos removal.

3.03 ASBESTOS REMOVAL

- A. Ensure that the "Competent Person" employed by the entity performing Work of this Section performs the following:
1. Ensures that workers are equipped with respiratory protection and personnel protective equipment in accordance with 1.06 B.3 herein.
 2. Ensures that the negative air filtration system and manometers are maintained and continuously operated throughout "Work Area" preparation, asbestos removal, clean up, and post-abatement air clearance sampling in accordance with the Contract Drawings.
 3. Ensures compliance with the procedures of 29 CFR 1926.1101, Appendix "F" - "Wetting Agents".
 4. Ensures that "Fire Safety" compliance with local fire department.

5. Ensures that prior to asbestos removal, all asbestos-containing materials are adequately wetted as regulated by the state in which the Work occurs.
 6. Ensures that removal of asbestos-containing material is in accordance with Appendix "A" to this Section and the Contractor's approved submittals.
 7. Ensures that debris and water does not remain or pond on the floor or temporary "Support Structures". (Adequately wet down, remove and bag material while wet, concurrently during removal operations utilizing HEPA vacuums, rubber or plastic dustpans, squeegees or plastic shovels to ensure continuous water and debris removal.)
 8. Ensures that disposal of waste water from the "Work Area"
 9. Ensures that a permanently bound entry logbook for each "Work Area" is maintained and made available for the Environmental Consultant's inspection and has been signed by all individuals who enter and leave the "Work Area(s)". The log shall identify the entity performing asbestos abatement Work.
 10. Ensures that the permanently bound daily log book for each "Work Area" is maintained with records of the Environmental Consultant's inspections and all findings, events and required corrective action regarding, but not limited to, daily inspections, integrity of the decontamination unit(s), "Isolation Barrier Partitions", "Critical Barriers", "Surface Barriers", negative air filtration system, and all "Work Area" cleanings.
 11. Unless directed by the Engineer to do otherwise, ensures that the condition of the waste container is examined by the "Fire Safety person (or "Competent Person" in the event that a Fire Safety person is not required) at least once every 24 hours during non-working periods, and that repairs of torn or missing signs on the waste container, or damage affecting the integrity of the waste container are performed or that replacement containers are provided.
 12. For Work in New York State, ensures compliance with the cleaning and surface lock- down encapsulation procedures in ICR 56, Subpart 56-9.1(b).
 13. Ensures that whenever possible, gross removal, packaging and cleaning proceeds generally from the top downward.
 14. Ensures that gross removal, packaging and cleaning proceeds from locations which are remote from the HEPA units toward the areas of the units.
 15. Ensures that wire brushes are not used for asbestos removal.
 16. Ensures that compressed air and high-pressure water or steam are not used for asbestos removal.
- B. Upon completion of the asbestos removal activities, notify the Environmental Consultant in writing at least 24 hours in advance to perform the final inspection and final air-clearance activities.
- C. Should the area beyond the Work Area(s) become contaminated with asbestos containing materials or elevated fiber levels, contractor shall immediately stop Work and institute emergency clean-up procedures. Contaminated non-Work Areas shall be isolated and decontaminated in accordance with procedures established for asbestos removal. All costs incurred in decontaminating such non-Work Areas and the contents thereof shall be borne by the Contractor.

3.04 ASBESTOS WASTE DISPOSAL

- A. Notify the Environmental Consultant in writing at least 24 hours in advance of any bag out operations or waste container removal.
- B. Remove asbestos waste from the "Work Site" only with the approval from the Environmental Consultant. Prepare and sign the Waste Shipping Document.
- C. Transport the waste consignment to the landfill designated in the Contractor's approved submittals and EPA notification letter.

- D. The collection, co-mingling and transport of generated asbestos waste with the asbestos waste from other generator sources is prohibited. Temporary storage or secondary transfer of the asbestos waste before final disposal is prohibited, unless otherwise approved in writing by the Environmental Consultant prior to the waste leaving the "Work Site".
- E. Package, label, and remove all asbestos waste from the work area in accordance with NYS-DOL, and all other applicable regulations, and as specified below. Packaging shall be accomplished in a manner that minimizes waste volume, but insures waste containers shall not tear or break.
- F. Waste Labeling
1. Warning labels, having waterproof print and permanent adhesive in compliance with OSHA, EPA and NY-DOL/NY-DOT requirements shall be affixed to or printed on the sides of all waste bags or transfer containers.
 2. In compliance with NESHAP, 40 CFR, Part 61.150, all waste containers or bags shall be labeled with the following generator information:
 - a. Name of waste generator
 - b. Location of where waste was generated
- G. Waste Container Storage: The container used for the storage of bagged contaminated waste shall be an enclosed dumpster. Dumpster shall have a solid metal roof, solid metal door with padlock. As a minimum, line the cargo area with two layers of a 6-mil polyethylene sheeting to prevent contamination from damaged or leaking containers. Floor sheeting shall be installed first and shall extend up the sidewalls 24 inches minimum. Wall sheeting shall be overlapped and taped securely into place. No unbagged contaminated waste or non-asbestos waste shall be stored in these dumpsters. Ensure that bags placed in dumpsters are undamaged. Warning signs shall be posted on the dumpster in accordance with Sections 29 CFR 1926.1101 of the OSHA regulations.
- H. Waste Transportation and Disposal
1. It is the responsibility of the Contractor to determine and insure that his/her subcontractor are complying with: 1) current waste handling regulations; and 2) the current regulations for transporting and disposing waste at the ultimate disposal landfill.
 2. The Contractor's waste hauler and disposal contractor shall maintain a valid hazardous waste transporter's permit and identification number; and obtain complete, and fully comply with any other local hazardous waste manifesting requirements.
 3. Exercise care before and during transport to ensure that no unauthorized persons have access to the containerized ACW.
 4. Do not transport ACW on open trucks. Treat and dispose of drums that have been contaminated as asbestos containing waste.
 5. A copy of ACW manifest forms shall be sent to the Owner after each disposal is completed and all required data and signatures have been inserted.
 6. The Contractor shall return the original Disposal Certificate (landfill receipt) to the Owner within 10 working days of waste shipment from the site.

3.05 AIR MONITORING

- A. The Environmental Consultant retained by the Owner shall perform asbestos abatement project and air monitoring as per NYS-ICR 56 requirements.
- B. Personal OSHA Monitoring - The Contractor is solely responsible for performing personal air monitoring as specified by the OSHA 29 CFR 1926.1101 and the OSHA Respiratory Protection Standard 29 CFR 1910.134.
 - 1. The Contractor shall arrange and pay for all costs of the testing. Laboratories used shall be currently enrolled in the American Industrial Hygiene Association Proficiency Analytical Testing Program or an equivalent recognized program.
 - 2. Results of all OSHA monitoring shall be provided to the Owner within 24 hours after collection of the samples.

3.06 PROJECT CLOSE-OUT REPORT

- A. The final report shall not be a substitute for the requirements of the Section of GENERAL PROVISIONS entitled "Asbestos Cost Summary Submittal".
- B. Final payment will not be approved prior to the Contractor preparing, itemizing and submitting to the Environmental Consultant of a final report containing:
 - 1. A cover page identifying the entity performing Work of this Section with their phone number and business address, name of the "Competent Person", name and business address of the CIH and analytical laboratory, name and business address of the asbestos waste transporter, and name and business address of the landfill.
 - 2. A summary of the type(s) of material removed, quantity of material removed, description of work area preparation, waste generated, and date(s) transported from facility.
 - 3. Daily project logs, entry logs, and if applicable, time and material sheets.
 - 4. Analytical results of employee exposure air monitoring performed during Work of this Section, and strip or disk chart recordings of differential air pressure to areas adjacent to the "Work Area(s)".
 - 5. Waste Shipment Record signed by the operator of the disposal site indicated in the Contractor's approved submittals.
 - 6. Workers acknowledgment form filled by Workers and Supervisor (Copy included in Appendix B).
 - 7. The name, title and signature of the person preparing the final report.
 - 8. Provide appropriate certification stating that all identified ACM included in the scope of work have been properly removed and disposed in accordance with Federal, State and local regulations and these specifications.

APPENDIX "A"

PROJECT SPECIFIC REQUIREMENTS

A. Description

This Section specifies removal of asbestos-containing material from the "Work Area(s)" (shown on the Contract Drawings H-101.00 thru H106.00) and (listed below).

Material	Survey Results	Estimated Quantity to be Removed
GROUND LEVEL - EXTERIOR		
Concealed waterproofing materials (tar/membrane) on foundation walls	Assumed ACM	1,340 SF
Concealed waterproofing materials (tar/membrane) on grease interceptor walls, floor and deck	Assumed ACM	130 SF
Concealed waterproofing materials (tar/membrane) on retaining walls	Assumed ACM	1,800 SF
Concealed waterproofing materials (tar/membrane) on associated with gas and water lines	Assumed ACM	300 LF
BASEMENT		
Pipe insulation in wall sleeve	ACM	2 LF
High voltage cable/transformer wire/bushing insulation putty	Assumed ACM	5 SF
Concealed waterproofing materials (tar/membrane) on foundation walls	Assumed ACM	5 SF
Concealed waterproofing materials (tar/membrane) on column footing and under concrete floor slab	Assumed ACM	500 SF
Concealed suspect materials (Transite pipes, tar/membrane) associated with sanitary pipes under floor slab	Assumed ACM	50 LF
Transite/ebony elements with electrical panel boxes	Assumed ACM	20 SF
1ST FLOOR		
Door caulk (confirmed presence)	ACM	45 LF
Transite with transom door window paneling (confirmed presence)	ACM	30 SF
Pipe insulation (assumed presence within ceiling plenums and wall cavities)	ACM	100 LF
Elevator shaft core door insulation	Assumed ACM	50 SF
Elevator car core door insulation	Assumed ACM	40 SF
Suspect materials concealed within elevator walls, floor and ceiling	Assumed ACM	320 SF
Concealed suspect materials associated with terracotta flue	Assumed ACM	70 SF
Concealed waterproofing materials (tar/membrane) on walls behind brick veneer	Assumed ACM	70 SF
Suspect flooring materials (i.e. VAT, mastic, linoleum, etc.) (assumed presence)	Assumed ACM	435 SF
Transite/ebony elements with electrical panel boxes	Assumed ACM	20 SF
2ND FLOOR		

Material	Survey Results	Estimated Quantity to be Removed
Pipe insulation	ACM	14 LF
Door caulk	ACM	20 LF
Transite with transom door window paneling	ACM	18 SF
Pipe insulation (assumed presence within ceiling plenums and wall cavities)	ACM	100 LF
Elevator shaft core door insulation	Assumed ACM	50 SF
Concealed suspect materials associated with terracotta flue	Assumed ACM	70 SF
Concealed waterproofing materials (tar/membrane) on walls behind brick veneer	Assumed ACM	260 SF
Transite/ebony elements with electrical panel boxes	Assumed ACM	20 SF
3RD FLOOR		
Transite with transom door window paneling (assumed presence)	ACM	24 SF
Pipe insulation (assumed presence within ceiling plenums and wall cavities)	ACM	150 LF
Elevator shaft core door insulation	Assumed ACM	50 SF
Concealed suspect materials associated with terracotta flue	Assumed ACM	70 SF
Concealed waterproofing materials (tar/membrane) on walls behind brick veneer	Assumed ACM	250 SF
Suspect flooring materials (i.e. VAT, mastic, linoleum, etc.) (assumed presence)	Assumed ACM	1,500 SF
Transite/ebony elements with electrical panel boxes	Assumed ACM	20 SF
ROOFS		
Built-up roofing and roof flashing materials, roof mastic/tar, deck screed, etc.	Assumed ACM	500 SF

SF = Square Feet; LF = Linear Feet

NOTES:

1. During the abatement, contractor shall assist the owner's Environmental Consultant to assess and sample inaccessible suspect materials which were identified as assumed ACM. If the identified assumed ACM is not found or is confirmed to be non-ACM via laboratory testing, the owner shall be credited for the removal that is not performed. The credit shall be in accordance with the preassigned approved unit rate schedule.
2. In areas where ACM flooring is identified, remove all layers of flooring materials including tiles, covering, plywood, ceramic tiles, bedding mortar, wood/engineered panels, mastic, felt, screed, etc. down to the structural substrate as ACM. The Contractor shall perform necessary demolition including shoring of partition walls and remove concealed ACM flooring materials.

3. The removal of the built-up roofing and flashing is limited to areas affected by roof penetrations and/or new HVAC and other installations. In areas where roofing/flashing removals, remove all layers of built-up roofing and roof flashing materials (bituminous layers, tar/mastic, foam/rigid roof insulation, contaminated insulation, flashing, screed, etc.) down to the substrate as asbestos waste. The structural deck, parapet wall and miscellaneous equipment supports affected by the scope of work shall be free of any debris, residual tar, screed and extraneous materials.
4. All components in direct contact with concealed and exposed ACM and affected by the scope of work shall be treated as contaminated and removed/disposed, or cleaned as applicable. This includes but is not limited to, brick, mortar, fiberglass pipe and duct insulation, ceiling panels, sashes, frames, ducts, etc. For the removal of non-porous materials, contractor has the option to decontaminate and dispose the materials as regular construction & demolition (C&D) waste.
5. The exact locations of the concealed and exposed materials shall be field verified by the contractor during the construction. Whether identified or not, abate all exposed and concealed ACM and contaminated materials affected by the project at no additional cost to the owner. The abatement contractor must certify that all concealed ACM affected by the project have been removed from the building. Contractor shall re-mobilize at no additional cost to the Owner, if additional concealed ACM is identified during renovation. The project may require multiple remobilizations.
6. Prior to filing abatement notification, contractor shall prepare detailed abatement work plan indicating limits of each work area including locations of decontamination units, emergency egress routes, etc.

B. Temporary Utilities

1. Electricity

Electricity is available at the "Work Site" at the location(s) designated by the Building Engineer, subject to such conditions and precautions upon its use as may be imposed by the Engineer. The Owner will pay the cost of power used. Connect to existing service; furnish and install temporary branch wiring and distribution boxes located to allow power and lighting by means of construction-type power cords with ground-fault interrupter(s). Completely remove temporary materials when their use is no longer required. In the event of asbestos contamination of temporary materials, clean and decontaminate by wet cleaning and/or HEPA vacuuming in the "Work Area"; dispose of as ACM waste.

If electricity is not available at the "Work Site", provide generator(s) approved by the Building Engineer with grounded temporary service distribution system of size, capacity and power characteristics required to perform the Work of this Section. Furnish and install temporary ground-fault interrupter(s). In the event of asbestos contamination of temporary materials, clean and decontaminate by wet cleaning and/or HEPA vacuuming in the "Work Area"; dispose of as ACM waste.

2. Cold Water

Cold water is available at the "Work Site". Coordinate with the Engineer for the location of water source. The Owner will pay the cost for water used. In the event of asbestos contamination of temporary materials, clean and decontaminate by wet cleaning and/or HEPA vacuuming in the "Work Area" or dispose of as ACM waste. Restore existing facilities to their original condition. Provide backflow protection at all connections to the water supply system.

3. Drainage

Drainage is available at the "Work Site" without charge to the Contractor at the location(s) designated by the Engineer, subject to such conditions and precautions upon its use as stipulated in "Water Disposal Procedures" herein. Completely remove temporary materials, clean and decontaminate by wet cleaning

and/or HEPA vacuuming in the "Work Area", or dispose of as ACM waste. Restore existing facilities to their original condition.

- C. Utilities and Services in Work Area to be Shut Down.
- D. Water Disposal Procedures: Prior to disposal of waste water, filter through a new three stage filter system where the final stage is a 5.0 micron filter to remove asbestos fibers.
- E. The Contractor must cooperate with the on-site abatement Project Monitor (Environmental Consultant) retained by the Owner and maintain the project schedule. Should the project require final clearance air testing during non-working hours, the supervisor must remain on the site during the sampling.
- F. The Contractor must provide power, extension cords, GFCI and other miscellaneous electrical supplies for the Project Monitor to perform air sampling inside and outside the work areas.

END OF APPENDIX "A"

APPENDIX "B"
CERTIFICATE OF WORKER'S/SUPERVISOR'S ACKNOWLEDGMENT

BUILDING NUMBER: _____
PROJECT ADDRESS: _____
CONTRACTOR FIRM NAME: _____

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH TYPES OF LUNG DISEASE AND CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NONSMOKING PUBLIC.

I; _____, License # _____
_____ is aware of the hazards of working with Asbestos. I have been supplied with proper personal protective equipment including a respirator, that I have been trained in its use; and that I have received a medical examination to evaluate my physical capacity to perform the assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment.

FORMAL TRAINING

a. For Supervisors:

_____ As a Competent persons and supervisors: I have completed EPA's model Accreditation Program (MAP) training course, "Contractor/Supervisor", which meets this state's requirements. I have completed annual refresher training as required by EPA's MAP that meets this state's requirements.

b. For Workers:

_____ I have completed EPA's MAP training course, "Asbestos Worker", which meets this state's requirements. I have completed annual refresher training as required by EPA's MAP that meets this state's requirements.

PROJECT SPECIFIC TRAINING:

_____ I have been provided and have completed the project specific training required by this contract. My employer's Designated Industrial Hygienist and Designated Competent Person conducted the training.

RESPIRATORY PROTECTION:

_____ I have been trained in accordance with the criteria in the contractor's Respiratory protection program. I have been trained in the dangers of handling and breathing asbestos dust and in the proper work procedures and use and limitations of the respirator(s), I will wear.

RESPIRATOR FIT-TEST TRAINING:

_____ I have been trained in the proper selection, fit, use, care, cleaning, maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in the contractor's respiratory program and have received a satisfactory fit. I have been assigned my individual respirator.

MEDICAL EXAMINATION:

_____ I have had a medical examination within the last twelve months which was paid for by my employer. The examination included: health history, pulmonary function tests, and may have included an evaluation of chest X-ray. A physician made a determination regarding my physical; capacity to perform work tasks on the project while wearing personal protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination and there were no limitations to performing the required work tasks.

Employee signature _____ date _____

Contractor's Industrial Hygienist Signature _____ date _____

APPENDIX "C"

WASTE MANIFEST LOG

Building Address:		
Asbestos Contractor:		
Project Monitor:		
Project #:		

[illegible]

COMMENTS:

END OF SECTION 02 08 00

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SECTION 02 08 60

REMEDATION OF HAZARDOUS AND UNIVERSAL WASTE ARTICLES

PART 1 – GENERAL

1.1 SUMMARY

- A. This specification addresses environmental and administrative controls to be undertaken by the Contractor when handling (removal, transport and disposal) universal waste including but not limited to pesticides, batteries, polychlorinated biphenyl (PCB) containing lighting ballasts, mercury containing electrical and mechanical articles such as lamps, pressure gauges, thermostats, refrigerants, emergency light fixtures, electronic articles, etc. from all project impacted building areas.

The removal of Hazmat and Universal Waste must be performed prior to any other renovation activities. The off site disposal must be performed at Environmental Protection Agency (EPA) approved treatment, storage and disposal facility. Such facilities must be pre-approved by the Owner and their representatives prior to offsite shipment of any waste.

- B. The light ballast/capacitors within the structures are assumed to be PCB containing. Ballast/Capacitors with no identification label or which are labeled as PCB containing shall be removed and disposed of as PCB-containing materials. The table below provides general information regarding possible types of Hazardous and Universal Waste that exist or may exist within the building areas impacted by proposed renovation activities.

Article/Device	Approx. Quantity		Comments
UNIVERSAL WASTE GROUP			
Fluorescent lamps	TBD	Units	See Note 1.
Emergency lights with Batteries	TBD	Units	See Note 1.
Batteries	TBD	Units	See Note 1.
MCE Thermostats	TBD	Units	See Note 1.
HID, MVC, HPS, MH lamps	TBD	Units	See Note 1.
Compact Fluorescent Lamp (CFL)	TBD	Units	See Note 1.
WASTE CONTAINING RADIOACTIVE MATERIALS* GROUP			
Smoke detectors	TBD	Units	See Note 1.
Exit signs	TBD	Units	See Note 1.
PCBs CONTAINING WASTE* GROUP			See Note 1.
Fluorescent Light Ballasts	TBD	Units	See Note 1.
Electronic equipment containing circuit boards with capacitors such as Computers and Peripherals, Telephones, TVs, etc.	TBD	Units	See Note 1.
Wall mounted electronic devices containing circuit boards with capacitors	TBD	Units	See Note 1.
Electrical motors containing capacitors (associated with pumps, fans, shutter door openers, etc.)	TBD	Units	See Note 1.
Hydraulic Lift Systems (hydraulic pumps, cylinders, pistons, oil tanks, oil heater/cooler, etc.)	TBD	Units	See Note 1.
Voltage Regulator (Old Liquid containing Transformers)	TBD	Unit	See Note 1.
WASTE CONTAINING CFCs and/or HCFCs* GROUP			
Interior mounted A/C, HVAC, Air Handling, cooling units	TBD	Unit	See Note 1.
Exterior mounted A/C, HVAC, Air Handling, cooling units	TBD	Units	See Note 1.

Article/Device	Approx. Quantity		Comments
Rooftop mounted A/C, HVAC, Air Handling, cooling units	TBD	Units	See Note 1.
Refrigerator/Water Fountain	TBD	Units	See Note 1.
MIXED HAZARDOUS WASTE GROUP			
Fire extinguishers	TBD	Units	See Note 1.
Chemicals (Bottles/Cans)	TBD	Units	See Note 1.
Paint containers	TBD	Units	See Note 1.
Electrical power supply modules with fluid	TBD	Units	See Note 1.
Drum with various chemical fluid (50 Gallon)	TBD	Unit	See Note 1.
<p>Note 1:</p> <p>A full protocol Hazmat survey was performed for limited building areas that will be impacted by proposed renovation activities as part of our scope of work. Prior to performing any planned renovation and/or redevelopment activities, a full protocol hazmat survey of all impacted building areas will be necessary to confirm the quantities and locations of universal/hazardous articles.</p> <p>* - Due to live electricity and building's operations the ballasts associated with the light fixtures and other electrical devices are assumed to contain PCBs; EXIT signs and smoke detectors are assumed to contain radioactive materials; and heat transformer systems are assumed to contain CFCs and/or HCFCs.</p> <p>MCE - Mercury-Containing Equipment; HID - High Intensity Discharge; MVC - Mercury Vapor Containing; HPS - High Pressure Sodium; MH - Metal Halide; CFCs - Chlorodifluoromethanes (R-12); HCFCs - Hydrofluorocarbons (R-22)</p>			

- C. The identification of aforementioned items is for information purposes only. Whether identified or not, all Universal and Hazmat articles present on the property shall be removed prior to demolition.
- D. Contractor shall follow administrative and engineering controls when disturbing any building component coated with detectable levels of lead in paint (Lead-Containing Paint). Work activities that would create dust shall be performed in a controlled environment following safe work practices and good housekeeping activities. The paint associated with the metal components that would be impacted by welding or torch cutting activities shall either be removed prior to performing such activities or appropriate engineering controls and respiratory protection shall be employed during such work. The workers performing the paint removal activities must be trained under the requirements of 29 CFR 1926.62. The waste generated must be appropriately tested in accordance with the Resource Conservation and Recovery Act (RCRA) regulations and disposed accordingly.
- E. The work, in general includes, but is not limited to, the following:
1. Partial dismantling of light fixtures and separation of ballasts to permit removal.
 2. Cleaning of any PCB oil contamination or fixtures' surfaces.
 3. Best Management Practices for spill pallets for drums shall be implemented.
 4. Placement of all PCBs or PCB-contaminated items generated as a result of work activities in approved open top drums.
 5. Marking and labeling of all Universal Waste Articles for storage purposes.
 6. Transportation of Universal Waste Articles, Items and Containers to off-site treatment, storage, and disposal facilities.

7. Provide properly completed and executed Uniform Hazardous Waste Manifest from the transporter and certificate of destruction from the treatment, storage and disposal facility.
8. PCB and Mercury-containing devices shall be stored in a safe place in a solid leak-proof container in such a way as to avoid breakage, leakage, spills or releases.

1.2 DEFINITIONS

- A. Contractor: The successful awarded bidder for this Contract.
- B. The Environmental Consultant – An “Environmental Consultant” means a Consulting Firm or its employee retained by the Owner to overlook this project and perform project monitoring and air sampling.
- C. Leak: Leak or leaking means any instance in which a PCB or mercury article, PCB container, or electrical equipment has any PCBs on any portion of its external surface.
- D. Lamps: Lamp, also referred to as "universal waste lamp", is defined as the bulb or tube portion of an electric lighting device. A lamp is specifically designed to produce radiant energy, most often in the ultraviolet, visible, and infra-red regions of the electromagnetic spectrum. Examples of common universal waste electric lamps include, but are not limited to, fluorescent, high intensity discharge, neon,
- E. Mercury vapor, high pressure sodium, and metal halide lamps.
- F. Polychlorinated Biphenyls (PCBs): PCBs as used in this specification shall mean the same as PCBs, PCB containing lighting ballast, and PCB container, as defined in 40 CFR 761, Section 3.
- G. Spill: Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.
- H. Universal Waste: Universal Waste means any of the following hazardous wastes that are managed under the universal waste requirements 40 CFR 273:
 - (1) Batteries
 - (2) Pesticides
 - (3) Thermostats
 - (4) Lamps
 - (5) Electrical Relays/switches
- I. Hazardous waste shall be any materials to be disposed that possess at least one of four characteristics, ignitability, corrosivity, reactivity or toxicity, as defined and regulated by the Resource Conservation and Recovery Act (RCRA) and applicable state and federal regulations, or a material specifically identified as hazardous waste by applicable Federal or State lists, in 40 CFR 261 or 6 NYCRR 371.
- J. A Conditionally Exempt Small Quantity Generator (CESQG) of hazardous waste shall be a waste handler who generates no more than 100 kilograms per month of listed and/or characteristic hazardous waste, generates no more than 1 kilogram of acute hazardous waste in any calendar month, and stores no more than 1000 kilograms of listed and/or characteristic hazardous waste or more than 1 kilogram of acutely hazardous waste.

- K. A Small Quantity Generator (SQG) of hazardous waste shall be a waste handler who generates no more than 1000 kilograms per month of listed and/or characteristic hazardous waste, generates no more than 1 kilogram of acute hazardous waste per month, and stores no more than 6000 kilograms of listed and/or characteristic hazardous waste or more than 1 kilogram of acutely hazardous waste.
- L. Large Quantity Generator (LQG) of hazardous waste shall be a waste handler who generates more than 1000 kilograms per month of listed and/or characteristic hazardous waste, generates more than 1 kilogram of acute hazardous waste per month, or stores more than 6000 kilograms of hazardous waste or 1 kilogram of acutely hazardous waste.
- M. The Owner's Consultant: The Owner shall provide a third party consultant to provide pre-work assessments, project monitoring assessments for the construction procedures for the work area and surrounding areas and final clearance assessments. The Contractor shall be responsible for the worker protection requirements.

1.3 RELATED SECTIONS AND DOCUMENTS

- A. All work must be performed in accordance with the other Contract Documents prepared for the project. Applicable Specification Sections include but are not limited to:
 - 1. 02 08 00 – Asbestos Abatement
 - 2. Asbestos Containing Materials Identifications Plans (H-101.00 thru H-106.00)
 - 3. 02 83 00 – Management of Lead Containing Paint

- B. References

- 1. The universal waste inventory identified on the Drawing is provided as a reference. Whether identified or not, the Contractor must remove all universal waste from the structures at no additional cost to the owner.

Also note that the above documents are provided to all prospective bidders for reference only. Neither the Owner nor the preparer of each document takes any responsibility for the accuracy of completeness of the information provided therein. Each bidder shall rely on his own investigation and on-site visit in the preparation and submission of his bid. No claim for additional work or compensation shall be entertained due to discrepancies between information which may be provided on the drawings or documents and actual field conditions.

- 2. The applicable sections, latest editions and addenda of the following government regulations, codes, industry standards and recommended practices, form a part of these specifications. Nothing in these specifications is to be construed as permitting work not conforming to these requirements:
 - a. EPA - Environmental Protection Agency (40 CFR 761, 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 268, 40 CFR 270, and 49 CFR 178.
 - b. NYS-DEC - New York State Department of Environmental Conservation
 - c. NEC - National Electrical Code
 - d. NEMA - National Electrical Manufacturers Association
 - e. RCRA - Resource Conservation and Recovery Act
 - f. TSCA - Toxic Substances and Control Act

- g. DOT - Department of Transportation
 - h. New York City Fire Department
 - i. All other applicable Federal, state, county and city codes, standards and regulations.
3. The Contractor is cautioned that it is responsible for ascertaining the extent to which these regulations affect the operations and to comply therewith.

1.4 SUBMITTALS

- A. Submit copies of complete lists of all materials and equipment proposed for use in the work. List shall include such items as protective clothing, breathing apparatus, sorbents, solvents, drums, Article and Item containers, etc. Give name of manufacturer, brand name and catalog number of each item where applicable. In addition, submit copies of Safety Data Sheets.
- B. Submit copies listing addresses of the applicable regulators listed in Section 1.03 herein, 24-hour manned telephone numbers, home telephone numbers by work status of personnel working on project.
- C. Submit a job-specific plan within 20 (twenty) calendar days after award of contract of the work procedures to be used in the removal, packaging, and storage of PCB-containing lighting ballasts and associated mercury-containing lamps. Include in the plan: Requirements for Personal Protective Equipment (PPE), spill cleanup procedures and equipment, eating, smoking and restroom procedures. The plan shall be approved and signed by the Certified Industrial Hygienist. Obtain approval of the plan by the Environmental Consultant prior to the start of PCB and/or lamp removal work.
- D. Submit method of removal and routes to be taken to exterior and loading area.

1.5 QUALITY ASSURANCE

- A. The work under this section includes the handling of highly toxic substances and materials requiring special expertise. Therefore, specific qualifications must be met by the Contractor or its agent.
- B. Single Party Responsibility: The Contractor performing the work of this section shall be responsible for, and accomplish, all universal waste-related activities as included herein.
- C. License Requirements: The Contractor performing the hauling work of this section must be currently licensed by the State of New York, and possess a current EPA authorization number for the transporting and hauling of extremely hazardous wastes, including PCB's.
- D. Fees and Permits: Contractor shall pay all necessary fees and permits related to the removal, handling, transportation and disposal of universal waste.

1.6 COORDINATION

- A. All work activities related to universal waste handling, storage, and disposal shall be performed by the Contractor and must be coordinated with the demolition contractor to minimize potential toxic exposure.
- B. Notify the Environmental Consultant and the Owner 10 days prior to the start of any universal waste removal work.

1.7 SCHEDULING OF WORK

- A. Prior to commencing any work, thoroughly inspect the work area and prepare a construction schedule which lists anticipated time frames and sequence of operations for the various work activities.
- B. The construction schedule shall include activities such as contamination clean-up, removal of all PCB Articles, Items and containers from the work area to an off-site authorized disposal location. The construction schedule shall also include routing for all PCB items to be removed from the work area and transported to disposal areas. Work activities, sequence of work and routing scheme shall be approved by the Environmental Consultant.

1.8 SAFETY PROCEDURES AND WORKER PROTECTION

- A. Take all precautions and measures required to protect employees, related trade employees, inspection personnel, and the general public from exposure to PCB and Mercury solids, liquids and vapors.
- B. Permanently disconnected power source prior to commencing removal of electrical articles from the structures.
- C. Work Area Protection and Marking: Prior to commencing removal of any Universal waste, provide barricades and warning signs to clearly identify and effectively guard against unauthorized entry into work area.
- D. All equipment shall be confined to the work area until work is complete and containers are sealed and equipment properly and safely stored for transport.
- E. Protective measures shall be provided with the transportation of PCB and universal waste materials within the structures for the entire pathway to the transporting vehicle.
- F. Protective Clothing and Equipment: At all times when PCB materials in any volume are not sealed in drums, containers or electrical equipment, workers shall wear:
 - 1. Disposable, non-porous gloves
 - 2. Disposable, whole body clothing impermeable to PCB's
 - 3. Respiratory protection (NIOSH/MSHA approved) against organic vapors and particulate (at least the level of particulate protection required at that stage of work for asbestos protection).The Contractor shall have a respiratory protection program established, which will be in compliance with ANSI Z228.2, OSHA 29 CFR 1910 and 1926, 40 CFR 763, Subpart G, and 42 CFR Part 84. All respiratory protection will be MSHA/NIOSH approved in accordance with the provisions of 30 CFR Part 11.
 - 4. Eye protection
- G. The Contractor shall provide protective clothing, eye protection, and respiratory protection as required for authorized inspection personnel monitoring work activities within the work area.
- H. Personnel Protection and Procedures: The work areas shall at no time be left unattended after universal waste removal procedures have begun and until all waste is packed and sealed in approved containers. If immediate transportation to the disposal facility is not feasible, the work area must be secured in a manner approved by the Environmental Consultant. During removal and clean-up procedures all personnel entering the work area must don protective clothing. Upon exiting the work area, all disposable protective clothing shall be placed in open-top drums, sealed, and removed from the property when other materials in same areas are removed.

- I. Workers with cuts or scratches shall seal these wounds with "Newskin" or similar product before entering the work area. Similarly, workers who accidentally incur minor cuts or scratches in the course of work activities shall leave the work area, cleanse the wound with medical grade soap and seal the wound before returning to the work area.
- J. The Contractor shall develop a plan for all universal waste-related work and submit this plan in advance of such work to the Owner and the Environmental Consultant in advance order to address the following items:
 - 1. Lists of vehicles, equipment and personnel to be used in accomplishing the work.
 - 2. Emergency spill plan encompassing all steps the Contractor will take in the event of a spill or other emergency.
 - 3. Safety procedures shall cover all phases of operations including, but not limited to, handling, loading, transporting, securing waste loads and First aid procedures.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Storage Containers:
 - 1. All ballasts containing PCB material and mercury containing switches shall be stored in sealed DOT 17C or 17H type drums. All fluorescent lamps, [and high intensity discharge (HID) lamps shall be packed in cardboard boxes.
 - 2. All PCB solid wastes, including disposable items used in the course of the work such as rags, sorbents, protective clothing, etc., shall be stored in sealed DOT 17C or 17H type drums.
- B. Solvents, Sorbents and Cleaners:
 - 1. Solvents recognized for a high degree of PCB solubility. Contractor shall be required to provide copies of all Safety Data Sheets (SDS) to the Owner and the Environmental Consultant for all chemicals to be used on site. The Contractor shall obtain approvals from the Owner and Environmental Consultant on chemicals to be used prior to their arrival on site.
 - 2. Sorbents: Material recognized for a high degree of absorption.
 - 3. Liquid Cleaners: Concentrated liquid alkaline base cleaner. Contractor shall be required to provide copies of all SDSs to the Owner and Environmental Consultant for all chemicals to be used on site.

PART 3 – EXECUTION

3.1 WORK PROCEDURES

- A. Furnish labor, materials, services, and equipment necessary for the removal of PCB containing lighting ballasts, mercury-containing fluorescent lamps, high intensity discharge (HID) lamps, electrical switches, emergency lights, etc. in accordance with local, state, or federal regulations. Do not expose PCBs to open flames or other high temperature sources since toxic decomposition by-products may be produced. Do not break mercury containing fluorescent lamps or high intensity discharge lamps.

- B. Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761, 40 CFR 262, 40 CFR 263, and the applicable requirements of this section, including but not limited to:

1. Obtaining suitable PCB and mercury-containing lamp storage sites.
2. Notifying on site Environmental Consultant prior to commencing the operation.
3. Reporting leaks and spills to the Environmental Consultant and the Owner.
4. Cleaning up spills.
5. Inspecting PCB and PCB-contaminated items and waste containers for leaks.
6. Maintaining inspection, inventory and spill records.

3.2 SPILL CLEAN-UP, CONTAINERIZATION AND MARKING

- A. Clean-up of Work Area, Articles and Spills:

1. Equipment and Tools: After the last unit of electrical lighting has been separated from ballasts, all tools and equipment used in the work shall be decontaminated and properly stored for reuse.
 - a. Where work surfaces have contacted PCB fluids, they shall be scraped clean, flushed with solvent, wiped clean and all debris placed in open type drums.
 - b. All tools that may have come in contact with PCB at any concentration shall be thoroughly flushed with solvent, wiped clean and properly stored.
2. PCB Articles (Electrical Equipment): All exterior surfaces of electrical equipment to be removed that may have come in contact with PCB's or contaminated oils or fluids either during the course of work activities or due to past leaks shall be thoroughly cleaned with solvent and wiped clean. Contractor shall clean surfaces to 10 micrograms per 100 square centimeters (10 mg/100 cm²).
3. Slabs, Floors and Walls: All concrete (or other surfaces) which have come in contact with PCB's or PCB mixtures in the course of the work as a result of past leaks shall be thoroughly cleaned using a combination of sorbents, solvents and cleaners.
4. Where feasible, the Contractor shall arrange to remove such Articles directly to transport vehicles prior to general clean-up.
5. Spilled Mercury can be cleaned up easily from wood, linoleum, tile and any similarly smooth surfaces. If a spill occurs on carpet, curtains, upholstery or other absorbent surfaces, the affected portion of the contaminated carpet shall be properly disposal.

- B. Containerization and Marking:

1. All liquids generated as a result of work activities and clean-up operations shall be placed in closed top drums and sealed.
2. All solids such as sorbents, rags, disposable protective clothing, and other incidentals shall be placed in closed top drums and sealed.

3. All drums (and Article containers where used) shall be permanently marked as to specific contents and dated. In addition, each drum (and container) shall be marked with the standard EPA, PCB ML label.
4. All PCB Articles such as ballasts and other equipment to be removed shall have a record of such action sealed in a weatherproof envelope displayed on the unit. Label record must include the type of action taken, date of action and the name of the technician in charge. A duplication of this label information shall be furnished to the Environmental Consultant.
5. A lamp that is broken must be cleaned up and placed in a container. The container must be closed, structurally sound, compatible with lamps, and lacking any evidence of spillage.
6. All mercury-containing bulbs and lamps shall be placed in a cardboard box prior to transporting in a larger container.
7. Other mercury containing items shall be placed in leak tight containers. Kitty litter or oil-absorbent matter should be placed around the product to protect it from breaking or sudden shocks.

C. PCB Release Limits:

1. The Contractor shall limit the airborne PCB concentration to below one microgram per cubic meter (1 mg/m³) of air following a clean-up.
2. The Contractor shall limit the PCB concentration of structures surfaces to below 10 micrograms per 100 square centimeters (10 mg/100 m²).
3. If required, air monitoring data shall include the sorbent type, sampling rate, sampling volume, analytical method, mass of PCB's detected, and limit of detection, as per NIOSH analytical method 5503. Surface monitoring shall include the filter type, sorbent type, sampling, location area sampled, analytical method, mass of PCB's detected and the limit of detection as per NIOSH analytical method 5503. Analytical results for PCB analysis shall be provided to the Environmental Consultant within 24 hours of the end of work on any weekend or 24 hours of the removal of the ballasts.

3.3 HANDLING AND TRANSPORTATION TO OFF-SITE DISPOSAL FACILITIES

A. Handling:

1. Drums: All closed top drums must be permanently sealed and marked prior to loading on transport vehicle. Filled drums shall be loaded on the transport vehicle by any of the following methods:
 - a. By a hoist or lift truck utilizing a two-point drum lifter.
 - b. By a hoist or lift truck provided with a band-around type drum lifter.
 - c. By a lift truck lifting the drums from underneath by a pallet attached to the drum by a banding arrangement.
2. Drums shall not be lifted by:
 - a. Any rope, chain or cloth slings tied about the drum.
 - b. Placement of drums on bare-lift truck forks.

- c. Forcing drums between forks of a lift truck, or
 - d. Any commercial drum lifters exerting force on the sides of a drum.
- 3. All drums or Article containers shall be secured to the transport vehicle to prevent movement in transit.
- B. Transportation to Disposal Facility:
 - 1. All Universal Waste Articles such as ballasts, lamps, all drums containing liquids, solids and incidentals shall be transported to the off-site disposal/recycling facility. The disposal/recycling facility shall be approved by the Owner.
 - 2. The Contractor (or their subcontractor) shall be licensed for the transportation and hauling of extremely hazardous wastes. The firm shall provide a routing plan which clearly identifies the routes it proposes to follow while transporting Universal waste items from the various work areas (points of generation) to the off-site disposal facility.
 - 3. A minimum of two operators shall be in attendance at all times when PCB items are being loaded and unloaded.
 - 4. Vehicles used for transporting of PCB Items must be plainly and visibly marked with a minimum of four EPA type ML PCB labels.
 - 5. Vehicles shall not be loaded in excess of 75% of rated load capacity.
- C. Unloading and Placement in Storage:
 - 1. Transport vehicles shall be unloaded utilizing the same equipment and methods as for loading.
 - 2. Immediately following unloading of the universal waste transport vehicle, the cargo area shall be inspected to check for any fluid leaks. If any fluids are found, the source of the leaking drum or Item shall be identified and sealed.
 - 3. The contaminated cargo area shall be thoroughly cleaned with sorbents, solvents and liquid cleaner. Cleaning solvents and solids shall be placed in proper drums.

3.4 RECORDS RETENTION

- A. Upon completion of all PCB work related activities, the Contractor shall provide a complete record of such activities and storage data to the Environmental Consultant. The record shall include but not be limited to:
 - 1. Name of the firm performing the work outlined in this Section and technician in charge.
 - 2. Ballasts and Electrical Equipment removed:
 - a. Manufacturer and serial number
 - b. Date removed from service and location
 - c. Date placed in disposal site
 - d. Weight in pounds
 - 3. Drums (and article containers where applicable):

- a. Drum size (30 or 55 gallon)
 - b. Identification of contents, i.e., ballasts, cleaning solvents, etc.; for solids, rags, sorbents, etc.
 - c. Weight in kilograms of contents of each drum (or container)
 - d. Date items were destroyed and location and company.
4. Fully-executed Hazardous Waste Manifests shall be provided for all hazardous waste materials. Hazardous waste manifests signed by the Owner and waste hauler shall be provided to the Environmental Consultant at the time that hazardous materials are removed from the property. Completed, signed Hazardous Waste Manifests shall be provided to the Environmental Consultant within five days of the time the hazardous waste materials are received at the disposal facility.

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SECTION 021000– PROTECTION OF EXISTING UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Project Specifications:
 - 1. Section 02 01 00 – Maintenance of Existing Conditions
 - 2. Section 31 90 00 – Trench Excavation and Backfill
- C. Project Documents:
 - 1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide protection of existing utilities in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
 - 1. Identification and field mark-out of all on-site utility lines within the project limits to remain in operation and/or be relocated during construction.
 - 2. Repair of any damage during construction operations.
 - 3. Protection and support of utilities during construction operations.

1.4 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Engineer.
- B. The Contractor must provide the following submittals to the Engineer, Architect, and Owner or Owner's Representative for approval prior to purchase of materials:
 - 1. Material Certificates: Submit materials certificate to the Engineer and Owner or Owner's Representative which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.

2. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.
3. Product Data: Submit manufacturers cut sheets, component construction, features, configurations and dimensions.
4. Product Certificates: Submit product certificate which is signed by manufacturer and Contractor, certifying that products comply with, or exceed, the requirements herein, and requirements identified on the construction documents.

1.5 CONTRACTOR RESPONSIBILITIES

- A. General coordination with other trades, Owner, etc.
- B. Notify affected utility companies and Owner before starting work and comply with their requirements.
- C. Contractor is responsible for protecting all utilities during construction as necessary

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.

1.7 PERMITS AND APPROVALS

- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work authorized by the permit.

1.8 PROJECT RECORD DOCUMENTS

- A. Upon completion of the work of this and related sections, the contractor shall provide the Owner with an as-built survey of all new storm sewer, water, , and gas service lines. The data shall include invert elevations at the connection point to the existing infrastructure, tied into established project benchmarks. The survey shall be provided in digital (AutoCAD DWG) and paper formats, and shall be signed and sealed by a New York State Licensed Professional Land Surveyor. This survey may be combined with other as-built survey requirements of site-work items, with the approval of the Owner. Marked-up design plans are not acceptable for the requirements of this section.
- B. The contractor shall accurately record any structures which exist on site and are not shown on the contract documents.
- C. A pre-construction and post construction survey of the condition of all utilities within the project limits to remain during construction shall be performed by the Contractor.
- D. The Contractor shall provide actual locations of capped utilities and subsurface obstructions that will remain after demolition. Submit records as part of closeout submittals.

1.9 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.

- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
 - 1. United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.

PART 2 - EXECUTION

2.1 IDENTIFICATION

- A. Existing Utilities: Locate existing underground utilities in and beyond the areas of work. If utilities are indicated to remain in place, provide adequate means of support and protection during the work. In the event of identifying and unforeseen conflict/condition, notify the Contractor immediately.
- B. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
- C. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by the construction Manager and then only after acceptable temporary utility services have been provided.

2.2 PROTECTION

- A. Prior to commencement of any work, consult the records for existing utilities, and note all conditions and limitations, which might affect the work.
- B. The Contractor shall become acquainted with the existence and location of all surface and subsurface structures and utilities within the project area. Contractor shall not damage any of those that are to remain and shall leave them accessible.
- C. The work shall be executed so that no damage or injury will occur to existing public and adjoining or adjacent structures, streets, paving, sewers, gas, water, electric or any other pipes. Should any damage or injury caused by the Contractor, or anyone in the Contractor's employ, or by the work under this Contract occur, the Contractor shall, at his own expense, make good such damage and assume all responsibility for such injury.
- D. The above shall also include the protection of all existing utilities (including sewers, water lines, electrical lines and telecommunication lines) to remain in use within and adjacent to the area affected by the work of the project.
- E. Monuments, bench marks and other reference features on streets bounding this project, shall be protected. Should these be disturbed in any manner, the Contractor shall have them replaced at own expense.
- F. Flag, barricade or suitably protect existing utilities during construction operations and equipment movement.

- G. At a minimum, Contractor shall provide timber mats at locations where equipment will cross existing utilities. Provide any other safety measures and follow any additional procedures requested by the utility owner.

2.3 DAMAGE

- A. Any damage to existing utilities by the Contractor or his subcontractors shall be immediately repaired with the least impact to the utility service and to the operational standards. If the repairs are not immediately addressed by the Contractor, the utility owner and/or the Owner will contract for the repair at the Contractor's expense.
- B. Post construction condition surveys shall be conducted by the Contractor. Any damage to the utilities shall be repaired to the condition identified in the preconstruction survey. The Engineer and/or utility owner shall determine the acceptability of any repairs.

END OF SECTION 021000

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
4. Section 020110 "Maintenance of Existing Conditions" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 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 or 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.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

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

1.4 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.

1.5 INFORMATIONAL SUBMITTALS

- A. 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.
- B. 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.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- E. Historic Surfaces and Materials: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches (300 mm) or more.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. 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.

1.9 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 ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. 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. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. 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.
 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 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. Arrange to shut off utilities with utility companies.
 2. 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.
 3. 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.

3.3 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 015000 "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.

3.4 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 three 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.

3.5 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."
- 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 075552.16 FL - Styrene-Butadiene-Styrene (SBS) Modified Bituminous Protected Membrane Roofing for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. 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.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.7 CLEANING

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

END OF SECTION 024119

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SECTION 02 83 00

MANAGEMENT OF LEAD CONTAINING PAINT

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section specifies environmental, administrative and engineering controls to be undertaken by the Contractor when disturbing building component coated with detectable levels of lead in paint (Lead-Containing Paint) for.
 - 1. The protection of Contractor workers, the public and the environment from exposure to harmful levels of lead that may be present in the paint being removed.
 - 2. Ensuring that all waste is collected, handled, stored, transported and disposed of in accordance with applicable regulations.
- B. All painted building components affected by the scope of work are assumed to contain detectable levels of lead. Work activities that would create dust shall be performed in a controlled environment following safe work practices, good housekeeping activities, and appropriate engineering controls. Respiratory protection shall be employed during such work. The workers performing the paint removal activities must be trained in accordance with 29 CFR 1926.62 requirements.
- C. Work activities that would create dust shall be performed in a controlled environment following safe work practices, good housekeeping activities, and appropriate engineering controls. Respiratory protection shall be employed during such work. The workers performing the paint removal activities must be trained in accordance with 29 CFR 1926.62 requirements.
- D. Hazardous Nature of Work: Contractor agrees and understands that Contractor and the subcontractor's employees are trained and experienced in the handling, removal, transportation and disposal of hazardous materials. The Contractor will at all times have an on-site a person who satisfies the current OSHA Competent Person Requirements, that has received all necessary certifications and licenses required by federal, state or local laws, statutes, orders, rules and regulations currently governing the removal, transportation and disposal of asbestos and hazardous materials. The Contractor's personnel performing the removal of hazardous and asbestos materials must have proper training, medical certification for respiratory protection.
- E. The Contractor shall not perform the following activities on painted surfaces: dry scraping, dry sanding, open-flame removal or on-site methylene chloride stripping. Other prohibited activities shall include but not be limited to, dry sweeping of dust, paint chips or debris, storage of debris, burning, etc.
- F. Remove paint from surfaces which would be impacted by torch cutting or welding activities.
- G. Remove paint by one or more of the following less dusty methods, subject to compliance with requirements and systems specified herein:
 - 1. Chemical stripping
 - 2. Wet abrasive procedures
 - 3. Contained abrasive procedures with HEPA vacuum attachment (There should be no visible airborne dust)
 - 4. Power-tool cleaning.

- H. Paint removal methods shall be environmentally safe, and they shall be non-caustic unless otherwise approved in writing by the Owner. Procedures shall be effective without causing damage to masonry and other substrates.
- I. All work which disturbs painted surfaces containing lead shall be performed in accordance with the Occupational Safety and Health Administration (OSHA), 29 CFR 1926.62 (Lead in Construction Standard) and US Environmental Protection Agency's (USEPA) 40 CFR 745 regulation. The Contractor shall be familiar with the OSHA and USEPA regulations and their requirements.
- J. In addition, all waste generated as part of the project, regardless of the lead content in the paint, shall be tested in accordance with the United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act to determine the classification of the waste.
- K. All waste shall be contained, collected and properly disposed of.
- L. The Contractor shall provide all labor, equipment, tools and materials necessary to complete the Work. The Contractor shall provide all necessary worker safety equipment and material and environmental protection materials necessary to complete performance of the Work in accordance with all prevailing regulations. All workers and supervisors involved in paint removal activities shall possess the required certifications as outlined in 40 CFR 745.
- M. The surfaces on which paint removal activities are to take place may have a number of different existing coatings applied to various masonry materials. The Contractor shall determine which of the removal systems specified herein to use.
- N. General clean-up of the area, which includes the collection of all spent residues, cloth, and placement into proper drums for disposal as specified herein.
- O. The Work performed shall comply with all applicable federal, state and local laws, rules, codes and regulations.
- P. The following methods of paint removal shall not be used:
 - 1. Dry open abrasive blasting
 - 2. Uncontained hydro-blasting
 - 3. Open flame
 - 4. Chemical strippers containing methylene chloride
 - 5. Any other method deemed inappropriate or unsafe by the Owner.

1.02 RELATED SECTIONS AND DOCUMENTS

- A. All work must be performed in accordance with the Contract Documents to be prepared for the project. Applicable Specification Sections include but are not limited to:
 - 1. 02 08 60 – Remediation Hazardous and Universal Waste Articles
 - 2. 02 08 00 – Asbestos Abatement
 - 3. Asbestos Containing Materials Identifications Plans (H-101.00 thru H-106.00)

1.03 DEFINITIONS

- A. Action Level: Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

- B. Area Sampling: Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).
- C. Competent Person (CP): an agent of the Contractor who is Competent Person as defined by OSHA 1926.62. This person must be capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization by the Contractor to take prompt corrective measures to eliminate them.
- D. Deleading Contractor - Any business entity, public unit, or person performing the actual abatement for lead abatement project.
- E. Demolition - The dismantling and removal of any building component, system, finish or assembly of a facility together with any related handling operations.
- F. Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.
- G. Contaminated Room: Refers to a room for removal of contaminated personal protective equipment (PPE).
- H. Decontamination Shower Facility: That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.
- I. High Efficiency Particulate Arrestor (HEPA) Filter Equipment: HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.
- J. Hazardous Waste – as defined in RCRA the term “hazardous waste” means a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may:
- a. cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or
 - b. pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.
 - c. As defined in the regulations, a solid waste is hazardous if it meets one of four conditions:
 - exhibits a characteristic of hazardous waste (40 CFR Sections 261.20 through 262.24).
 - has been listed as hazardous (40 CFR section 261.31 through 261.33).
 - is a mixture containing a listed hazardous waste and a non-hazardous solid waste (unless the mixture is specifically excluded or no longer exhibits any of the characteristics of hazardous waste).
 - is not excluded from regulation as hazardous waste.
- K. Lead: Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.
- L. Lead Control Area: A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

- M. Lead Permissible Exposure Limit (PEL): Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula: $PEL \text{ (micrograms/cubic meter of air)} = 400/\text{No. hrs worked per day}$.
- N. Material Containing Lead/Paint with Lead (MCL/PWL): Any material, including paint, which contains lead as determined by the testing laboratory using a valid test method. All painted components in this building are assumed to be MCL/PWL.
- O. Personal Sampling: Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of and centered at the nose or mouth of an employee.
- P. Physical Boundary: Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.
- Q. Toxicity Characteristic Leaching Procedure (TCLP): A laboratory test method to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multiphasic wastes performed in accordance with test methods required under 40 CFR Part 268.

1.04 REFERENCES

- a. General Applicability of Codes and Regulations: Except to the extent that more explicit or more stringent requirements are written directly into the Contract Documents, all applicable codes and regulations have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the Contract Documents, or as if published copies are bound herewith.
- b. Federal Requirements: which govern the management, hauling and disposal of hazardous waste include but are not limited to the following:
 - 1. Code of Federal Regulations (CFR) Publications:
 - 29 CFR Part 1926.62: Lead Exposure in Construction; Final Rule Vol. 58, No. 84
 - 29 CFR Part 1926.20: General Safety and Health provisions
 - 29 CFR Part 1926.21: Safety Training and education
 - 29 CFR Part 1926.23: First Aid
 - 29 CFR 1926.24: Fire Protection
 - 29 CFR 1926.25: Housekeeping
 - 29 CFR 1926.28: Personal protective equipment
 - 29 CFR 1926.33 Access to Employee Exposure and Medical Records
 - 29 CFR 1926.51(f): Washing facilities
 - 29 CFR 1926.55: Gases, vapor, fumes, dust, and mists
 - 29 CFR 1926.56: Illumination
 - 29 CFR 1926.57: Ventilation
 - 29 CFR 1926.59: Hazardous Communications Standard
 - 29 CFR 1926.62: Lead Construction Standard
 - 29 CFR 1926.103: Respiratory protection
 - 29 CFR 1926.353: Ventilation: Welding, cutting, or heating of metals of toxic significance
 - 29 CFR 1926.300: Hand and power tools
 - 29 CFR 1926.451: Scaffolding
 - 29 CFR 1926.500, 502, 503: Fall protection

- 29 CFR 1910.120: Hazardous Waste Operations and Emergency Response
 - 29 CFR 1910.134: Respiratory Protection
 - 40 CFR 61 Subpart A General Provisions (Hazardous Air Pollutants Listing)
 - 40 CFR 61.152: Standard for Waste Manufacturing, Demolition, Renovation, Spraying and Fabricating Operations
 - 40 CFR 241: Guidelines for the Land Disposal of Solid Waste
 - 40 CFR 257: Criteria for Classification of Solid Waste
 - 40 CFR 261 & 262: Waste Disposal Facilities & Practices
 - 40 CFR 260 Hazardous Waste Management System: General
 - 40 CFR 264 Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
 - 40 CFR 265 Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
2. SSPC Guide 6 - Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations.
 3. SSPC Guide 7 - Guide for Disposal of Lead-Contaminated Surface Preparation Debris.
 4. SSPC C3, Certification - Certification from a Supervisor / Competent Person Training for Deleading Industrial Structures Course.
 5. SSPC Publication 95-06 - Project Design.
 6. DOT: U.S. Department of Transportation, including but not limited to:
 - Title 49, Parts 171-180 of the Code of Federal Regulations
Hazardous Material Regulations, General Awareness and Training Requirements for Handlers, Loaders and Drivers
 - Hazardous Material Regulations
Editorial and Technical Revisions
Title 49, Parts 171-180 of the Code of Federal Regulations
 7. American National Standards Institute ANSI Publications
 - 88.2-80 Practices for Respiratory Protection
 - Z87.1 Eye Protection
 8. National Institute of Occupational Safety & Health (NIOSH) Publications:
Manual of Analytical Methods, 2nd Edition, Volume 1, Physical & Chemical Analysis Method (P&CAM)
 9. Underwriters Laboratories (UL)
UL 586 (1996; Rev thru Aug 2004) Standard for High-Efficiency Particulate, Air Filter Units
 10. EPA: U.S. Environmental Protection Agency (EPA), including but not limited to:
 - a. Management of Hazardous Wastes, Resource Conservation and Recovery Act (RCRA)
Title 40, Parts 260-268 of the Code of Federal Regulations
 - b. EPA Toxic Substances Control Act (TSCA), Polychlorinated Biphenyls (PCB's)
manufacturing, processing, distribution in commerce, and use prohibitions (90 CFR, Part 761).
 - c. State Requirements: which govern the management, hauling and disposal of hazardous waste.
 4. NYCRR Title 6, Chapter III, 364-373 - Hazardous Waste Management Regulations.

- a. Local Requirements: Abide by all local requirements which govern the management, hauling, and disposal of hazardous waste.

1.05 REGULATORY REQUIREMENTS

- A. Comply with the requirements of all applicable Federal, State, and City laws, codes, and regulations including, at a minimum, the regulations of the following:
 - 1. United States Environmental Protection Agency (EPA).
 - 2. Occupational Safety and Health Administration (OSHA).
 - 3. New York State Department of Environmental Conservation (NYSDEC).
 - 4. New York State Department of Health (NYSDOH).
 - 5. New York State Department of Labor (NYSDOL).
- B. Comply with all applicable regulations even if the regulation is not specifically referenced herein. If a Federal, State, or City regulation is more restrictive than the requirements of this Section, follow the more restrictive requirements.

1.06 QUALITY ASSURANCE

- A. Waste Handling Plan: Submit a waste handling plan that addresses the proper handling and disposal of all waste specified in 3.03 of this Section.
- B. Contingency Procedures Program: Submit a contingency procedures program to respond to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil or surface water at the construction site. Include the following:
 - 1. Emergency plan describing arrangements agreed to by local police departments, fire departments, hospitals and state and local emergency response teams. Include an evacuation plan for workers. Describe signals to be used to begin evacuation.
 - 2. List of names, addresses and phone numbers of all persons qualified to act as emergency coordinators. Include a list of all emergency equipment at the construction site (fire extinguishers, spill control equipment, communications and alarm systems and decontamination equipment).
 - 3. Evidence that a copy of the emergency plan has been submitted to all local police departments, fire departments, hospitals, state and local emergency response teams that may be called upon to provide emergency services.

1.07 SUBMITTALS

Submit the following:

- A. Catalog Cuts
 - 1. Catalog cuts for all equipment used in the performance of the Work.
 - 2. Catalog cuts for all Personal Protective Equipment including respirators and protective clothing.
 - 3. Catalog cuts for decontamination unit and hand wash station.
- B. Qualifications
 - 1. Qualifications, experience, training and certification information for the entity performing lead paint removal.
 - 2. Qualifications, experience, training and certification information for the subcontractors.

3. Qualifications, experience, training and certification information for the laboratories performing sample analysis.
 4. Qualifications, experience, training and certification information for the physician performing physicals.
 5. Qualifications, experience, training and certification information for the competent person/supervisor.
 6. Qualifications, experience, training and certification information for the workers.
 7. Names, addresses, qualifications and contact persons for the proposed transporter(s) of hazardous waste, non-hazardous waste and waste water. Furnish evidence that each transporter has current registration approved by NYSDEC, and/or DOT, as applicable.
 8. Name, address, telephone number and contact person for each waste disposal facility used in the Contract. Furnish evidence that each disposal facility has current registrations and permits for the operation of such facilities, or written approval from the state (and by the USEPA or other local agency, if applicable) in which it operates.
 9. Certifications for laboratory conducting blood work, certifications of occupational physician, and copies of blood lead and ZPP testing for Competent Person(s).
 10. Certifications for laboratory conducting blood work, certifications of occupational physician, and copies of blood lead and ZPP testing for workers.
- C. Record Documents
1. Site-specific Health and Safety Plan (HASP) that complies with 29 CFR 1926 "Safety and Health Regulations for Construction" signed by a Certified Industrial Hygienist. A site-specific Written Compliance Program (WCP) shall be part of the submitted HASP and it shall include the methods and procedures that will be followed for complying with this Section and 29 CFR 1926.62 Lead.

In addition, provide site specific Scope of Work information such as method of lead removal, lead work location(s), duration of lead work, crew size, login procedures, key personnel, Competent Person(s), containment classifications and the location of the WCP during the project. Said WCP shall be reviewed, accepted and signed by a Certified Industrial Hygienist and shall include at least the following:
 - a. Exposure Assessment program for site exposure assessments. Include details of personal air monitoring and note specific lead disturbance tasks. Identify personnel performing air sampling. Submit certifications of laboratory conducting air-sampling analysis. If historical data is to be used, submit to Engineer for evaluation.
 - b. Respiratory Protection program written in compliance with 29 CFR 1926.103. Address the selection, use, maintenance and inspection of respirators, and qualifications for respirator users. Include copies of fit test records for all crew and a letter from physician stating workers are fit to wear respirators.
 - c. Protective Clothing and Equipment program for selection, use, replacement and disposal of protective clothing and equipment.
 - d. Housekeeping program describing cleaning frequency, cleaning with HEPA vacuums, cleaning with biodegradable lead detergents, containerizing, storing and disposing of lead dust and paint chips.
 - e. Personal Hygiene Facilities and Equipment/Decontamination Zone program describing decontamination procedures, hand wash, showers, break areas and change areas.
 - f. Medical Surveillance and Medical Removal Protection program describing frequency and type of blood testing, medical removal, and physical examinations.

- g. Employee Training and Information program describing training requirements and frequency. Provide evidence of training for all workers.
 - h. Signs and Restricted Zones program for establishing restricted zones and use of Lead Work signs.
 - i. Record Keeping program describing record keeping procedures.
 - j. Visible Assessments program for assessments of visible emissions.
 - k. Chemical Safety and Handling program for the safe use and storage of chemicals on-site. Include MSDS for chemicals to be brought on-site.
- 2. Waste Handling Plan that addresses the proper handling and disposal of all waste.
 - 3. Contingency Procedures program.
 - 4. Copy of signed manifests for each load of waste material transported from the construction site. Furnish the manifest within one day of shipment.
 - 5. Copy of executed waste manifest form signed by a responsible party of the disposal facility. Furnish the form within one day of receipt. If the copy is not received within 35 days from the date of shipment, contact the Engineer, and assist as directed, in efforts to locate the manifest, and in the completion of the EPA Exception Reports.
 - 6. Certificate of final disposal for each manifest or certificate of recycling for recycled material. Furnish the certification within one day of receipt.
 - 7. Bills of Lading for the disposal of all non-hazardous municipal/construction waste within one week of the date of shipment.
 - 8. Written documentation of the receipt of disposal of all waste water within one week of the date of shipment.
 - 9. Clean-up letter report presenting the results of the inspections conducted to verify the final cleanliness of the construction site, surrounding property, waterways, equipment, buildings and structures.
- D. Contact Information
 - 1. Project Specific Chain of Command: Show on Chain of Command form(s) office, beeper, mobile and home telephone numbers of persons having the authority to dispatch personnel to the construction site and commit such persons to the tasks as directed by the Engineer. At a minimum include numbers for Project Supervisor, Competent Person and CIH.
- E. Closeout Submittals
 - 1. Copies of the Final Report as specified in 3.04 of this Section.

1.08 CONTRACTOR QUALIFICATIONS

- A. Laboratory Qualifications and Occupational Physician
 - 1. Verify that the analytical laboratories performing sampling and testing required under this Section are accredited by The American Industrial Hygiene Association (AIHA), and have successfully participated (previous 12 months at a minimum) in the AIHA Environmental Proficiency Analytical Testing (ELPAT) program.
 - 2. Verify that the laboratory conducting the worker blood analyses is approved by OSHA and NYSDOH.
 - 3. Verify the certifications of the Occupational Physician.
- B. Competent Person/Supervisor Performing Lead Paint Removal. Employ one who:
 - 1. Has a minimum of two years industrial painting field experience, with a minimum of ninety days field supervisory or management experience in paint removal projects.
 - 2. Has proof of completion of 29 CFR 1926.62 "Lead in Construction" training.

3. Has proof of 29 CFR 1910.120 (initial or refresher) Hazardous Waste Operations (HAZWOP) Supervisor training within the last 12 months.
 4. Has proof of training under the Resource Conservation and Recovery Act (RCRA), per 40 CFR 265.16.
 5. For Work in New York, has proof of completion of SSPC C3 course or equivalent. Certification must be maintained throughout the duration of the Contract.
- C. Workers Performing Lead Paint Removal. Confirm that:
1. All workers have proof of completion of 29 CFR 1926.62 "Lead in Construction" training.
 2. All workers have proof of training under RCRA, in accordance with 40 CFR 265.16.

1.09 RECORDKEEPING

- A. Contractor shall comply with 29 CFR Part 1926.62 for recordkeeping of all exposure monitoring, medical surveillance and other data used in conducting the employee exposure assessment to be established and maintained. These records shall be kept for 30 years in accordance with 29 CFR 1910.20, and employees shall have access to such records.

1.10 HYGIENE

- A. Contractor shall provide hygiene facilities and assure employee compliance with basic hygiene practices. This provision is recognized as an industrial hygiene tool for minimizing additional sources of lead absorption from inhalation or ingestion of lead that accumulates on a worker's hand, face or body. Hand washing facilities are to be provided for all employees occupationally exposed to lead in accordance with 29 CFR 1926.62.

1.11 PERSONAL AIR MONITORING

- A. Contractor shall perform representative personal air sampling data as defined within 29 CFR 1926.62. During the first day of demolition of components with a coating containing detectable levels of lead, the Contractor shall conduct initial exposure monitoring in order to establish a Time Weighted Average (TWA) exposure. TWA's shall be performed on a representative number of employees who are reasonably expected to have the highest exposure levels for each individual task. Such samples shall be collected within the appropriate breathing zone and used to determine if an upgrade in respirator requirements is needed and to determine the frequency of future air monitoring.
- B. Results of the monitoring shall be available in writing within two (2) working days.
- NOTE: Prior to receiving initial air monitoring data, the Contractor shall assume results are at or above the OSHA Permissible Exposure Limit (PEL) and protect employees accordingly.
- C. The Contractor shall be responsible for performing personal air monitoring on 25% of the workers that will be exposed to an activity that may potentially produce the highest concentrations of airborne lead.

PART 2 – PRODUCTS

2.01 PERSONAL PROTECTIVE MATERIALS AND MONITORING EQUIPMENT

- A. Monitoring and Testing Equipment
 - 1. Furnish the instrumentation needed for monitoring worker and area exposures.
 - 2. Furnish all equipment needed for the operation of instrumentation and monitors (e.g., generators, batteries, power cords and fuel).
- B. Personal Protective Equipment and Hygiene Facilities
 - 1. Furnish all personal protective equipment (PPE) needed for Contractor's workers and for up to 4 Authority representatives at each shift.
 - 2. Repair or replace PPE as required to assure that it continues to provide its intended purpose.
- C. Containment Materials
 - 1. Furnish all equipment and materials needed to contain debris in accordance with the provisions of this Section. This may include ground covers, rigging, scaffolding, planking, containment materials, dust collection and ventilation equipment and High Efficiency Particulate Air (HEPA) vacuums.

PART 3 – EXECUTION

3.01 WORKER PROTECTION CRITERIA FOR LEAD

- A. Competent Person: Confirm that daily inspections of the Work area will be made by a competent person.
- B. Written Compliance Program (WCP): Prepare a WCP in accordance with 29 CFR 1926.62 (e)(2)(i). Maintain a copy of the WCP at the construction site for review by all employees and interested parties.
- C. Engineering and Work Practice Controls: Implement engineering and Work practice controls, including administrative controls, to reduce and maintain employee exposure to lead below the Permissible Exposure Level (PEL).
- D. Exposure Monitoring/Initial Assessment: Collect representative personal air samples in accordance with 29 CFR 1926.62 (d)(1)(iii). Protect workers during initial exposure assessment in accordance with 29 CFR 1926.62 (d)(2)(i). If historical data will be used in accordance with 29 CFR 1926.62 (d)(3)(iii), provide prior to start of Work for evaluation by the Engineer.
- E. Respiratory Protection: Implement a Respiratory Protection program in accordance with 29 CFR 1910.134. Proper selection, use, maintenance and inspection of respirators is required. Provide medical clearance and fit tests for respirator users.
- F. Protective Clothing and Equipment: Furnish clean protective clothing and equipment in accordance with 29 CFR 1926.62 (g) and ensure they are used by all employees whose exposures exceed the PEL. Furnish closed containers for items to be cleaned, such as work shoes and facemasks. If the clothing is disposable, label the containers as clothing contaminated with lead, if applicable. Apply hazardous waste labels to drums containing PPE. If testing dictates that these materials are non-RCRA hazardous, re-label drums as non-hazardous and furnish testing records supporting this determination to the Engineer.
- G. Housekeeping: In accordance with 29 CFR 1926.62 (h), clean accumulations of dust or debris containing lead daily and conduct all cleaning with HEPA-filtered vacuums. Containerize the debris for proper disposal. Apply hazardous waste labels to drums containing dust and debris. If testing dictates that these materials are non-RCRA hazardous, re-label drums as non-hazardous and furnish testing records supporting this determination to the Engineer.

- H. Personal Hygiene Facilities and Equipment/Decontamination Zone: In accordance with 29 CFR 1926.62 (i), provide clean change areas, showers, lavatory, eating facilities and hand washing facilities as necessary for workers who may be exposed to lead at or above the OSHA PEL.
- I. Medical Surveillance and Medical Removal Protection: In accordance with 29 CFR 1926.62 (j) and (k), perform initial and periodic blood sampling and analysis for lead and zinc protoporphyrin (ZPP) when an employee is exposed to lead at or above the OSHA Action Level of 30 ug/m3. Furnish blood analysis results to the Engineer.
- J. Employee Training and Information: In accordance with 29 CFR 1926.62 (l), provide initial and annual refresher site specific training for all employees who may be exposed to lead at or above the OSHA Action Level.
- K. Signs and Restricted Zones: In accordance with 29 CFR 1926.62 (m), establish restricted zones around areas or activities that might generate airborne emissions of lead in excess of the OSHA Action Level and post caution signs around each restricted zone.
- L. Record Keeping: In accordance with 29 CFR 1926.62 (n), retain all records related to training, medical examinations, blood analysis, exposure monitoring, respirator fit testing, inspections by a competent person and other related documentation.
- M. Visible Assessments: Conduct daily assessments of visible emissions and releases to the air, soil, water and sediment, as applicable. Undertake all necessary corrective action to control emissions.

3.02 AMBIENT AIR MONITORING FOR LEAD

- A. High Volume Ambient Air Monitoring
 - 1. The Engineer will undertake high volume ambient air monitoring during paint removal and clean-up activities to confirm that emissions do not exceed the EPA National Primary and Secondary Ambient Air Quality Standards (NAAQS), or specific New York regulations.
 - 2. Total suspended particulate (TSP-lead) will be analyzed in accordance with 40 CFR 50 Appendix G.
 - 3. The number and location of monitors will be determined by the Engineer, taking into consideration proximity to homes, businesses and the general surroundings. Monitor siting and operation will be performed in accordance with the guidance provided in Methods A1 and A2 of SSPC publication 95-06, "Project Design".
 - 4. The Contractor will be advised if such monitoring will be performed and will be provided with verbal background and ongoing results. Written results will be provided if requested by the Contractor.
 - 5. Take corrective actions as directed by the Engineer and at no additional cost to the Authority if air monitoring results exceed the established concentrations. Corrective actions include:
 - a. Assessing all field data for that day and taking appropriate corrective actions to control emissions; and
 - b. Suspending dust producing operations (e.g., paint removal and clean-up) and implement appropriate corrective actions to control emissions.
 - 6. Regardless of the ambient air monitoring results, ensure at all times that no visible emissions occur.

3.03 ON-SITE MANAGEMENT, TRANSPORTATION, AND DISPOSAL OF PAINT DEBRIS, WASTEWATER, AND ANY OTHER WASTE GENERATED FROM THE WORK

- A. General

1. Collect, handle, store, transport and dispose of all hazardous wastes generated from this Work. The Authority will provide the EPA identification number for lead waste disposal for permitting purposes.
 2. Collect, handle, transport and dispose of all solvent wastes generated from this Work. The Contractor shall acquire their own EPA identification number for the disposal of solvent wastes.
 3. Collect, handle, transport and dispose of all non-hazardous municipal and construction waste and waste water generated from this Work.
 4. Recover all waste products generated during the paint removal Work including, but not limited to rags, tape, disposable coveralls, filters and sediments.
 5. Store waste only at locations designated by the Engineer. Inventory and transport hazardous waste to the designated 90-day-central-accumulation-storage-area at the end of each Work period, at a minimum.
 6. Obtain hazardous waste generation reports and pay for fees/taxes imposed by the States.
- B. Containers Provided by the Contractor
1. Hazardous Waste: Furnish DOT-approved containers of the appropriate size and type for the hazardous waste generated, including but not limited to, paint chips, protective clothing, and the interior lining of the containment. Use containers that are resistant to rust and corrosion (painted if constructed of steel), that have tight fitting lids or covers, and which are water resistant and leak proof.
 2. Municipal and Construction Waste: Furnish containers for non-hazardous municipal and construction waste. Use containers that are free of loose debris when brought to the construction site.
 3. Spent Solvents: Furnish DOT-approved containers for spent solvents. Do not mix spent solvents with paint debris, water or other lead contaminated waste.
- C. Waste Sampling, Testing and Classification
1. Sampling: Collect for analysis by the Authority, representative samples of each waste stream generated by the Work. Collect the samples under the observation of the Engineer.
 2. Testing (Hazardous Waste Determination)
 - a. Solid Waste: The laboratory will be directed and paid by the Authority to test the solid waste in accordance with 40 CFR 261, Appendix II, Method 1311, "Toxicity Characteristic Leaching Procedure" (TCLP), to determine if it is hazardous (equal to or greater than 5 mg/L).
 - b. Waste water: Test the waste water for Total metals (As, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Zn), hexavalent chromium, pH, suspended solids, oil and grease, biochemical oxygen demand (BOD), temperature, total cyanide, total petroleum hydrocarbons (TPH) and other analytical parameters required for discharge or characterization or by the disposal facility.
 3. Laboratory Report
 - a. Include the following minimum information in each report: Identity of the RCRA listed waste streams and identity of the waste stream(s) analyzed; the number of samples collected and tested; dates of sampling and testing; laboratory test procedures utilized; the names and signatures of the individuals collecting the samples and analyzing the laboratory tests; interpretation of the test results; and final determination.
 - b. Include copies of the chain-of-custody forms in the documentation of hazardous waste and non-hazardous waste streams.

D. Waste Handling, Packaging and Storage

1. Comply with 40 CFR 262 for the on-site handling, packaging and storage of all waste generated by the Work of this Section.
2. All paint debris shall be vacuumed and collected in DOT-approved 55-gallon drums at the end of each Work period. Paint debris shall include only paint chips and dust and shall not include any other construction debris, trash or chemical solvents. All disposable protective clothing and interior lining of the containment system shall be collected in DOT-approved drums at the end of each Work period.
3. At the Work areas, store waste in locations designated by the Engineer. Do not place hazardous waste on unprotected grounds (e.g., cover the ground with impervious tarping). Locate in a secure area with signs around the perimeter, and shield adequately to prevent dispersion of the waste by wind or water.
4. Properly transport all non-hazardous waste municipal and construction waste from the Work areas to the designated storage area. Verify that the waste is completely covered during transportation.
5. Maintain all drums in good operating condition with all lids and closing mechanisms intact and operational to prevent escape of debris by winds, spilling of contents and access by unauthorized personnel.
6. Store non-hazardous waste separately from hazardous waste. Do not mix hazardous waste with non-hazardous waste. Do not mix different types of hazardous waste unless specifically approved by the Engineer.
7. Verify that all waste is transported to the appropriate recycling or disposal facility within 60 days after waste is first placed into the container.
8. Train all personnel in the proper handling of hazardous waste at the Work site in accordance with 29 CFR 1910.120, including the procedures to follow in the event of a release or spill, required notifications and methods of clean-up. Maintain all training records on-site.

E. Labeling of Containers

1. Immediately label all containers of waste and paint debris to identify the contents. Label containers of paint debris as "LEAD PAINT WASTE, CONTAINS LEAD". Include the Contract number and locations. Provide similar labels on containers of other waste, wastewater and debris.
2. After the TCLP test results are received, or after determination of hazardous waste status based on RCRA list at 40 CFR 261, Subpart D, immediately apply hazardous waste labels, if the waste tests hazardous. Label each container of hazardous waste in accordance with 40 CFR 262 and 49 CFR 171-179.

F. Waste Transportation and Disposal (with the Exception of Waste Water)

1. Hazardous Waste
 - a. Prepare the hazardous waste manifest for each shipment and furnish to the Engineer for review and signature.
 - b. Arrange for the transportation of all hazardous waste by a licensed transporter in accordance with 40 CFR 263, 49 CFR 171-179 and 6 NYCRR 364.
 - c. Hazardous Paint Waste (TCLP results which indicate that lead concentrations are equal to or greater than 5 mg/L) shall be treated and stabilized to TCLP levels below 0.75 mg/L prior to disposal.
 - d. Furnish a certification for each manifested shipment that the waste was accepted by the recycling or disposal facility, and properly treated and disposed. Comply with all of the manifesting, certification and reporting requirements for hazardous waste in accordance with 40 CFR 262, 40 CFR 268 and 6 NYCRR 372, including certificates of final disposal for each shipment.

2. Non-Hazardous, Municipal and Construction Waste
 - a. Properly transport and dispose of all non-hazardous, municipal and construction waste.
 - b. Verify that waste is completely covered during transport.
 - c. If lead or hazardous substances were detected during the laboratory testing, notify the disposal facility that such metals or materials are present in the waste.
 - d. For non-hazardous lead waste with TCLP results which indicate lead concentrations between 1 mg/L and 5 mg/L, the waste shall be treated and stabilized to TCLP levels below 0.75 mg/L prior to disposal.
 - e. Comply with additional City and local regulations as applicable.
- G. Waste Water Handling and Disposal
 1. Furnish containers for the collection and retention of all waste water including, but not limited to, the water used for steam cleaning, hygiene purposes, decontamination and cleanup activities. Filter visible paint chips and particulate from the waste water prior to placing it into the containers. Make disposal arrangement with the local publicly owned treatment works (POTW), sanitation company or other appropriate permitted facility.
- H. Cleaning of Haul Routes: Clean waste transportation haul routes upon completion of operation at end of each hauling.

3.04 FINAL REPORT

- A. Payment for removal of LCP will not be approved by the Engineer prior to the Contractor preparing, itemizing and submitting to the Engineer copy of a final report containing:
 1. A cover page identifying the entity performing Work of this Section with their phone number and business address, name of the "Competent Person", name and business address of the CIH and analytical laboratory, name and business address of the waste transporter and name and business address of the disposal facility.
 2. Summarize the type(s) of lead material removed, quantity of lead material removed, description of containment and engineering controls, amount of waste generated and date(s) transported from facility.
 3. Daily project logs, entry logs, and if applicable, time and material sheets.
 4. Analytical results of employee exposure air monitoring performed during Work of this Section.
 5. Waste Shipment Record signed by the operator of the disposal facility indicated in the Contractor's approved submittals.
 6. The name, title and signature of the person preparing the final report.

END OF SECTION 02 83 00

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Form liners.
 - 3. Shoring, bracing, and anchoring.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 (ACI 301M).
 - a. Location of construction joints is subject to approval of the Architect.
 - 2. Indicate location of waterstops.
 - 3. Indicate form liner layout and form line termination details.
 - 4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
 - 5. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.

- B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with 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, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).

- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 WATERSTOPS

- A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Sika Corporation.
 - 2. Profile: Flat dumbbell with center bulb.
 - 3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.8 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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Carlisle Coatings & Waterproofing Inc.
 - b. Henry Company.
 - c. Sika Corporation.

2.4 RELATED MATERIALS

- A. 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.
- B. 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.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. 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.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- F. 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.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301 (ACI 301M).
- 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) and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
 1. Surface Finish-1.0: ACI 117 Class D, 1 inch (25 mm).
 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).
 3. Surface Finish-3.0: ACI 117 Class A, 1/8 inch (3.0 mm).
- D. Construct forms tight enough to prevent loss of concrete mortar.
 1. Minimize joints.
 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 1. Provide and secure units to support screed strips
 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches (305 mm).

- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 3. Place joints perpendicular to main reinforcement.
 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls not exceeding dimensional requirements of ACI 301.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 3. 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.

4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
 4. Secure waterstops in correct position at 12 inches (305 mm) on center.
 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.
 6. Clean waterstops immediately prior to placement of concrete.
 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 1. Install in longest lengths practicable.
 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 3. Protect exposed waterstops during progress of the Work.

3.4 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. 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.
 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 - 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

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SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.
 - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
 - 3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
 - 1. Location of construction joints is subject to approval of Architect.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For testing and inspection agency.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 - 2. Mechanical splice couplers.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.
 - 2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
 - 4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, ASTM A775/A775M epoxy coated.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
 - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

- D. Mechanical Splice Couplers: ACI 318 (ACI 318M) Type 2, same material of reinforcing bar being spliced; tension-compression type.
- E. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.
 - 1. Finish: Galvanized.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
- G. Install structural thermal break insulated connection system in accordance with manufacturer's instructions.
- H. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

- a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches (305 mm).
- 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches (50 mm) for plain wire and 8 inches (200 mm) for deformed wire.
- 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
- 4. Lace overlaps with wire.
- I. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. 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.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117 (ACI 117M).

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel-reinforcement placement.
 - 2. Steel-reinforcement mechanical splice couplers.
 - 3. Steel-reinforcement welding.
- C. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

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

- B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Maximum w/cm.
4. Slump limit.
5. Air content.
6. Nominal maximum aggregate size.
7. Synthetic micro-fiber content.
8. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
9. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
10. Intended placement method.
11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

- C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
 3. Testing agency: Include copies of applicable ACI certificates.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Field Quality-Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.7 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.
 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. 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).
 3. Do not use frozen materials or materials containing ice or snow.

4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.
5. 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 ACI 305.1 (ACI 305.1M), and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II.
2. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.3 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Synthetic macro-fibers engineered and designed for use in concrete, complying with ASTM C1116/C1116M, Type III, 1 to 2-1/4 inches long.

2.4 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. W. R. Meadows, Inc.

2.5 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. Dayton Superior Corporation.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Laticrete International, Inc.
 - d. Sika Corporation.
 - e. 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 C171, polyethylene film burlap-polyethylene sheet.

- D. Water: Potable or complying with ASTM C1602/C1602M.
- E. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dayton Superior Corporation.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Laticrete International, Inc.
 - d. W. R. Meadows, Inc.

2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 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 to 6 mm) or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4000 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 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 in accordance with ASTM C109/C109M.

2.8 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, in accordance with ACI 301 (ACI 301M).
 1. Use a qualified 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. Slag Cement: 50 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 1. Use high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.9 CONCRETE MIXTURES

- A. Normal-weight concrete as indicated on drawings.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 2. Face laps away from exposed direction of concrete pour.
 - 3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.
 - 4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
 - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 - 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls not exceeding dimensional requirements of ACI 301. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form control 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 control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control 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 cracks.
- D. Isolation Joints in Slabs-on-Ground: 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 on Drawings.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.

2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
 - C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
 - D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
 - E. 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.
 1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. 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.
 - F. 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. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1 inch (25 mm).
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
 - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1/4 inch (6 mm).
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
 - e. Locations: Apply to concrete surfaces to receive a rubbed finish or to be covered with a coating or covering material applied directly to concrete.
3. ACI 301 (ACI 301M) Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1/8 inch (3 mm).
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:
- C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. 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 6 inches (150 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 5000 psi 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. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.

2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Begin curing immediately after finishing concrete.
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.

- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

b. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) 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.

3.11 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least one month(s).
 2. 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.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
1. Repair and patch defective areas when approved by Architect.
 2. 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.
 - a. Limit cut depth to 3/4 inch (19 mm).
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. 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.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including 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.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. 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.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. 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.

3.14 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.

- 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections:
1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Slump Flow: ASTM C1611/C1611M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete .
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
 6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

- a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
- 7. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of three 6-inch (150 mm) by 12-inch (300 cylinder specimens for each composite sample.
 - b.
- 8. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
- 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
- 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- 12. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.
- 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

- 1. Protect from petroleum stains.
- 2. Diaper hydraulic equipment used over concrete surfaces.
- 3. Prohibit vehicles from interior concrete slabs.
- 4. Prohibit use of pipe-cutting machinery over concrete surfaces.

5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. 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.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 033010 – CAST-IN-PLACE SITE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Drawings and general provisions of the Contract.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following exterior concrete:
 - 1. Spread Footings.
 - 2. Concrete Pads/Slabs.
 - 3. Walls.
 - 4. Stairs/Ramps.
 - 5. High Curb.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast- furnace slag, and silica fume; subject to compliance with requirements.
- B. Mass Concrete: For purposes of this project, mass concrete is defined as any concrete placement four feet or greater in the least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. 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, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, and testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Curing compounds.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Semirigid joint filler.
 - 9. Joint-filler strips.
 - 10. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Field quality-control test and inspection reports.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI- certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel 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. 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 through single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D1.4M, "Structural Welding Code-Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete."
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 3. ACI 216, "Guide for Determining Fire Endurance of Concrete Elements".
- G. Concrete Testing Service (if used): Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce 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.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
- C. Steel Wire: ASTM A 1064/ A 1064M, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- 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.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 1. Portland Cement: ASTM C 150, Type I, II, or I/II. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class C or F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 2. Blended Hydraulic Cement: ASTM C 595, Type (PM), pozzolan-modified portland cement.
- B. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal, 1½" maximum at concrete thicknesses greater than 4".
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C 330, 3/4-inch nominal maximum aggregate size.
- E. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set- accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: Slurry coat, Type I or Type II cement, mixed to a maximum water to cement ratio of 0.62
- C. 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 IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. For Mass Concrete, additionally refer to ACI 211.1.
 - 2. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume may be used to reduce the total amount of portland cement. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent. 25 percent
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
- 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, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.9 CONCRETE MIXTURES FOR SITE ELEMENTS

- A. Minimum Compressive Strength and air content as indicated on contract documents.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C116M, 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.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 3. 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

- A. Design, erect, shore, brace, inspect, and maintain formwork, according to ACI 301 and ACI 347, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch Class C, 1/2 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, 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. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of walls 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 structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- 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 Engineer.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M), ACI 347 and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of tolerances is complete.
- 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 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would 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.

3.6 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 Engineer.
 - 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 into concrete.
 - 3. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to the greater of one-fourth of concrete thickness or 1 inch as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - 2. The aspect ratio of slab panels formed between joints shall be a maximum of 1.5 to 1; however, a ratio of 1:1 is preferred.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants 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.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for slabs and ramp 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.
- F. 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.
 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.

G. Hot-Weather Placement: Comply with ACI 301 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.

3.8 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. 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.

3.9 FINISHING PADS/SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, reststraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Broom Finish: Apply a broom finish to exterior concrete steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, brush with a wet soft hair brush to a neat workmanlike surface perpendicular to main traffic route. Coordinate required final finish with Architect before application.

C. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate or aluminum granule finish where indicated and to concrete stair treads and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread dampened slip-resistive aggregate or aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate or aluminum granules.

3.10 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including slabs and other surfaces.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete, Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 5. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.13 FIELD QUALITY CONTROL

- A. Except as otherwise indicated on drawings or specified herein, all work under this Section shall conform to applicable requirements of the local Building Code and regulations of all government authorities having jurisdiction, applicable State Code, and ACI 318.

B. Testing and Inspecting (if used): Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Contractor shall coordinate scheduling of testing and inspections with Owner's engaged agent

C. Inspections:

1. Steel reinforcement placement.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M, and either ASTM C617 (Bonded Caps) or ASTM C1231 (Unbonded Caps).
 - a. Cast and laboratory cure three sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure additional sets of two standard cylinder specimens for construction sequencing purposes as required.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days, two sets of two specimens at 28 days and hold one set of two specimens
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033010

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SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

B. Related Requirements:

1. Section 096248 "Isolated Concrete Flooring" for Sound Control Mat.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Test Reports:

1. For STC-rated assemblies, from a qualified testing agency.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

- 1. STC Rating: 60.

2.2 GYPSUM CEMENT UNDERLAYMENTS

- A. Gypsum Cement Underlayment: Engineered cementitious, self-leveling, gypsum cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Maxxon Corporation.
 - b. USG Corporation.

- 2. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.

- B. Aggregate: Sand shall meet ASTM C33 and specifications required by manufacturer.

- C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

- D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

- E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

- F. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

2.3 ACCESSORIES

- A. Sound Control Mat: As required to meet STC and IIC ratings, manufactured by gypsum cement underlayment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare and clean substrate according to manufacturer's written instructions.
 - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
 - 2. Fill substrate voids to prevent underlayment from leaking.
- B. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.
 - 1. Install underlayment reinforcement recommended in writing by manufacturer.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.
- D. Sound Control Mat: Install sound control materials according to manufacturer's written instructions.
 - 1. Do not install mechanical fasteners that penetrate through the sound control materials.

3.3 INSTALLATION

- A. Mix and install underlayment components according to manufacturer's written instructions.
 - 1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
 - 2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
 - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Install underlayment to produce uniform, level surface.
 - 1. Install a final layer without aggregate to product surface.
 - 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Apply surface sealer at rate recommended by manufacturer.
- G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 INSTALLATION TOLERANCES

- A. Finish and measure surface, so gap at any point between gypsum cement underlayment surface and an unleveled, freestanding, 10-foot- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3 mm).

3.5 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Lintels.
3. Brick.
4. Mortar and grout materials.
5. Reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Accessories.
9. Mortar and grout mixes.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.
3. Wall insulation adhered to masonry backup.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
 2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.
 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification: For each type and color of the following:
1. Clay face brick, in the form of straps of five or more bricks.
 2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence in accordance with ASTM C67/C67M.
 - 2. Cementitious materials. Include name of manufacturer, brand name, and type.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
 - 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- C. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches (610 mm) down both sides of walls, and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (610 mm) down face next to unconstructed wythe, and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
 - C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
 - D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
 - E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain exposed masonry units, cementitious mortar components, and mortar aggregate from single source or manufacturer.

2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 1. Where fire-resistance-rated construction is indicated, use the equivalent thickness method for masonry units in accordance with ACI 216.1.

2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C90, normal weight.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2500 psi.
 - 2. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.
 - 3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.4 LINTELS

- A. Solid Concrete Masonry Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength of not less than that of CMUs.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
 - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 - 2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Clay Face Brick: Facing brick complying with ASTM C216, Grade SW, Type FBS.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Belden Brick Company (The).
 - b. Endicott Clay Products Co.
 - c. Glen-Gery Corporation.
 - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi (23.10 MPa).
 - 3. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M.

4. Efflorescence: Provide brick that has been tested in accordance with ASTM C67/C67M and is rated "not effloresced."
5. Application: Use where brick is exposed unless otherwise indicated.
6. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.
7. Color and Texture: As selected by Architect to match existing.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.
- E. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 1. Colored Portland Cement-Lime Mix:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) SPEC MIX, LLC.
 2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 3. Pigments do not exceed 10 percent of portland cement by weight.
- F. Aggregate for Mortar: ASTM C144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch (6.4 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Aggregate for Grout: ASTM C404.
- H. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
 - 1. Interior Walls: Hot-dip galvanized carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized carbon steel.
 - 3. Wire Size for Side Rods: 0.187-inch (4.76-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.187-inch (4.76-mm) diameter.
 - 5. Wire Size for Veneer Ties: 0.187-inch (4.76-mm) diameter.
 - 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (406 mm) o.c.
 - 7. Provide in lengths of not less than 10 ft. (3 m).
- D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hohmann & Barnard, Inc.
- E. Masonry-Joint Reinforcement for Multiwythe Masonry:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Heckmann Building Products, Inc.
 - b. Hohmann & Barnard, Inc.
 - c. Wire-Bond.
 - 2. Truss type with one side rod at each face shell of hollow masonry units more than 4 inches (102 mm) wide, plus one side rod at each wythe of masonry 4 inches (102 mm) wide or less.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
 - 2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.
 - 3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 - 4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
 - 5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

6. Stainless Steel Bars: ASTM A276 or ASTM A666, Type 304.

- C. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (10-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- D. Rigid Anchor with Slotted Channel Anchor to Tie Masonry to Existing Construction: Fabricate from steel sheet 1-1/4" wide by 14 gauge by length to suit application. Use with channel slot anchor, 7-1/2 long by 12 gauge. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches (38 mm) wide by 1/4 inch (6.4 mm) thick by 24 inches (610 mm) long, with ends turned up 2 inches (51 mm) or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

2.9 EMBEDDED FLASHING

A. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Fabric Flashing: 5 oz./sq. ft. (1.5 kg/sq. m) self-adhesive copper sheet bonded between two layers of glass-fiber cloth.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1) Hohmann & Barnard, Inc.
- 2) Wire-Bond.

2. Polyester Scrim Reinforced Flashing: 40-mil thick membrane with pressure-sensitive clear adhesive.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1) Hohmann & Barnard, Inc.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

C. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm) with a 3/8-inch (10-mm) flange at top.

2.10 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vents: Use the following unless otherwise indicated:
 - 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3.2 mm) less than depth of outer wythe; in color selected from manufacturer's standard.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Hohmann & Barnard, Inc.
 - 2) Mortar Net Solutions.
- E. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
 - b. EaCo Chem, Inc.
 - c. PROSOCO, Inc.

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For mortar parge coats, use Type S.
 - 4. For veneer, use Type N.
 - 5. For exterior, above-grade, load-bearing, nonload-bearing walls, and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

6. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- C. Pigmented Mortar: Use colored cement product.
1. Pigments do not exceed 10 percent of portland cement by weight.
 2. Mix to match existing mortar.
 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
 - a. Exterior brick masonry.
- D. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C476, with a minimum 3000 psi compressive strength at 28 days.
 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

- 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6.4 mm).
- 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
- 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) total.

B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
- 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.6 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

- 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm), with a maximum thickness limited to 1/2 inch (13 mm).
- 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3.2 mm).
- 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6.4 mm).
- 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3.2 mm).

5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.6 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern to match existing; do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (102 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches (610 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 1. Install compressible filler in joint between top of partition and underside of structure above.
 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 16 inches o.c. unless otherwise indicated.
 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
 1. Bed face shells in mortar and make head joints of depth equal to bed joints.

2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
 2. Allow cleaned surfaces to dry before setting.
 3. Wet joint surfaces thoroughly before applying mortar.
 4. Rake out mortar joints for pointing with sealant.
- D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- F. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

3.6 COMPOSITE MASONRY

- A. Bond wythes of composite masonry together as follows:
1. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where bed joints of both wythes align, use truss-type reinforcement extending across both wythes.
 - b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.
- B. Bond wythes of composite masonry together using bonding system indicated on Drawings.
- C. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.
- D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.
1. Provide continuity with masonry-joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.
- E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are indicated at juncture, bond walls together as follows:
1. Provide individual metal ties not more than 16 inches (406 mm) o.c.

2. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.
3. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.7 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (152 mm).
 1. Space reinforcement not more than 16 inches (406 mm) o.c.
 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
- C. Form expansion joints in brick as follows:
 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (102 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
 3. Build in compressible joint fillers where indicated.
 4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

- D. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).

3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete or masonry lintels where indicated and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are indicated without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, AND CAVITY VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches (102 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (51 mm) on interior face.
 - 3. At lintels and shelf angles, extend flashing 6 inches (152 mm) minimum at each end. At heads and sills, extend flashing 6 inches (152 mm) minimum and turn ends up not less than 2 inches (51 mm) to form end dams.
 - 4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.
- E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
 - 1. Use specified weep/cavity vent products to form weep holes.
 - 2. Space weep holes 24 inches (610 mm) o.c. unless otherwise indicated.

3.11 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches (1524 mm).

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.
- B. Inspections: Special inspections in accordance with structural drawings.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

END OF SECTION 042000

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trim units.
2. Mortar materials.
3. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Selection.

1. For each color and texture of cast stone required, 4 inches (100 mm) square in size.
2. For colored mortar, make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by CSI Cast Stone Institute.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.

2. Store cast stone units on wood skids or pallets with non-staining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Cast Stone: Obtain cast stone units from single source from single manufacturer.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 CAST STONE UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Continental Cast Stone East; Russell, Inc.
 2. David Kucera, Inc.
 3. Southside Precast Products
 4. Sun Precast Company
 5. Edwards Cast Stone Company
- B. Cast Stone Units: Comply with ASTM C1364.
 1. Units are manufactured using the vibrant dry tamp or wet-cast method.
- C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.

3. Provide drips on projecting elements unless otherwise indicated.

D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch (3 mm).
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater, but in no case by more than 1/4 inch (6 mm).
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch (3 mm) on formed surfaces of units and 3/8 inch (10 mm) on unformed surfaces.

E. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
 - b. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

G. Colors and Textures: Match existing units.

2.3 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 042000 "Unit Masonry."
- B. Portland Cement: Provide natural color or white cement as required to produce mortar color indicated.
 1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

2.4 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- B. Dowels: 1/2-inch- (12-mm-) diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666.
- C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.5 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 SETTING CAST STONE IN MORTAR

- A. Set cast stone as indicated in TMS 604.
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.
 - 1. Set units with joints 3/8 to 1/2 inch (10 to 13 mm) wide unless otherwise required to match existing.
 - 2. Build anchors and ties into mortar joints as units are set.
 - 3. Fill dowel holes and anchor slots with mortar.
 - 4. Fill collar joints solid as units are set.
 - 5. Build concealed flashing into mortar joints as units are set.
 - 6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
 - 7. Keep joints at shelf angles open to receive sealant.
- E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- G. Tool exposed joints when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.
 - 1. Match existing tooling.
- H. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.
- I. Point joints with sealant to comply with applicable requirements in Section 079200 "Joint Sealants."
 - 1. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

- J. Provide sealant joints at head joints of copings and other horizontal surfaces; at expansion, control, and pressure-relieving joints; and at locations indicated.
 - 1. Keep joints free of mortar and other rigid materials.
 - 2. Build in compressible foam-plastic joint fillers where indicated.
 - 3. Form joint of width indicated, but not less than 3/8 inch (10 mm).
 - 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 - 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- B. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.
- C. Fill anchor holes with sealant.
 - 1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- D. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.
- E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
 - 1. Form open joint of width indicated, but not less than 3/8 inch (10 mm).
- F. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- G. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.4 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

- C. In-Progress Cleaning: Clean cast stone as work progresses.
1. Remove mortar fins and smears before tooling joints.
 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 5. Clean cast stone by methods described in Cast Stone Institute Technical Bulletin #39.
 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "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.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

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

- 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.
5. Identify members not to be shop primed.

- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand-critical welds.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, and testing agency.
- B. Welding certificates.
- C. Mill test reports for structural-steel materials, including chemical and physical properties.
- D. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 2. Tension-control, high-strength, bolt-nut-washer assemblies.
- E. Survey of existing conditions.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint [SSPC-QP 3].
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. As indicated on drawings.

2.2 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.

2.3 PRIMER

- A. Steel Primer:
1. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- F. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated on Drawings.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength 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 ANSI/AISC 303 for mill material.

2.6 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces unless indicated to be painted.
 6. Corrosion-resisting (weathering) steel surfaces.
 7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.
- C. Priming: Immediately after surface preparation, apply primer in accordance with 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.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 4. 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.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- C. 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. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- D. Splice members only where indicated.
- E. Do not use thermal cutting during erection.
- F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type 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 ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. 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.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

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SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.
 - b. Acoustical roof deck.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For welding personnel.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.3/D1.3M.
- B. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

2.2 ROOF DECK

- A. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
 - 1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), G60 (Z180) zinc coating.
 - 2. Deck Profile: As indicated.
 - 3. Profile Depth: As indicated.
 - 4. Design Uncoated-Steel Thickness: As indicated.
 - 5. Span Condition: [Double span.
 - 6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch (1.90 mm thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- I. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and level recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A780/A780M.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.
- J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
 - 1. Weld Diameter: **5/8 inch (16 mm, nominal).**
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches (300 mm) apart in Zone 1 and 6 inches (150 mm) apart in Zones 2 and 3, based on roof-area definitions in FM Global Loss Prevention Data Sheet 1-28.
 - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches (460 mm), and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 - 1. End Joints: Lapped 2 inches (50 mm) minimum or butted at Contractor's option.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 - 2. Steel decking will be considered defective if it does not pass tests and inspections.
 - 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.
- C. Prepare test and inspection reports.

END OF SECTION 053100

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Elevator pit sump covers.
3. Abrasive metal nosings, treads, and thresholds.
4. Metal floor plate trench covers.
5. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 077200 "Roof Accessories" for manufactured metal roof walkways and metal roof stairs.

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Steel shapes for supporting elevator door sills.
3. Metal floor plate and supports.
4. Elevator pit sump covers.

5. Loose steel lintels.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
2. Welding certificates.
3. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

B. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

D. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

- E. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- G. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.
- H. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.
- I. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- J. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

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 B633 or ASTM F1941/F1941M, 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 A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ISO 3506-1), and nuts, ASTM F594 (ASTM F836M).

2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- G. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

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.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 ELEVATOR PIT SUMP COVERS

- A. Provide covers using either of the following:
 - 1. Fabricate from 3/16-inch (4.8-mm) rolled-steel floor plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.
 - 2. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
- B. Provide steel angle supports unless otherwise indicated.

2.8 ABRASIVE METAL NOSINGS; TREADS; AND THRESHOLDS

- A. Cast-Metal Units: Cast aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Wooster Products, Inc; Alumogrit Cast Nosings.
 - 2. Source Limitations: Obtain units from single source from single manufacturer.
 - 3. Cross-hatched nosings, 4 inches (100 mm) wide, with 1/4-inch- (6-mm-) thick 1-inch (25-mm) lip, for casting into concrete.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Apply bituminous paint to concealed surfaces of cast-metal units.

- D. Apply clear lacquer to concealed surfaces of extruded units.

2.9 LOOSE BEARING AND LEVELING PLATES

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

2.10 LOOSE STEEL LINTELS AND MISCELLANEOUS SUPPORTS

- 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 one-twelfth of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.11 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.

2.12 METAL FLOOR PLATE TRENCH COVER

- A. Trench and Access Covers for Floors: Cast-in or block-out linear floor cover with 3/8 inch thick aluminum diamond plate by width indicated on drawings with recessed top for floor tile.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Balco; CSW Industrials Company; TST – Tile Recessed Plate Trench Cover.

2.13 GENERAL FINISH REQUIREMENTS

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
 - 5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- 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 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for curtain tracks and other miscellaneous items securely to, and rigidly brace from, building structure.

3.3 INSTALLATION OF METAL FLOOR PLATE

- A. Install metal floor plates flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.4 INSTALLATION OF ELEVATOR PIT SUMP COVERS

- A. Install tops of elevator sump pit cover plates and frames flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.5 INSTALLATION OF ABRASIVE METAL NOSINGS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

3.6 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.7 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel railings.

1.2 COORDINATION

- A. 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.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Nonshrink, nonmetallic grout.
 - 3. Paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For delegated design professional engineer.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
 - 1. Engineer to include any locations of expansion joints based on temperature changes expected and coefficient of expansion of metals involved
- B. Structural Performance: Railings, including attachment to building construction, 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.
- 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.

2.2 METALS, GENERAL

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

2.3 STEEL RAILINGS

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

- B. Tubing: ASTM A500/A500M (cold formed).
- C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.

2.4 FASTENERS

- A. Fastener Materials:
 - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
 - 3. Finish exposed fasteners to match 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 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 exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 - 2. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

- A. Side Wall Post Flange: Galvanized iron. Basis of Design: Kee Klamp Side Wall flange 68-7, welded to 5/16" galvanized steel plate; sizes as required to support structural loads.
- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting." . "

- F. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
 - 2. 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.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- 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 welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- J. Form changes in direction as follows:
 - 1. By flush bends or by inserting prefabricated flush-elbow fittings.

- K. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 - 2. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 - 2. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 3. 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. Shop-Painted Finish: Comply with Section 099113 "Exterior Painting."
 - 1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.

3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 4. 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.
 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 6. 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).
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

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

3.3 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. Attach posts to side of walls with wall brackets where indicated.
1. Locate brackets at spacing required to support structural loads.
- D. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.

3.4 REPAIR

- A. Touchup Painting:
1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting."

3.5 CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

3.6 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.
- B. 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.

END OF SECTION 055213

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SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Miscellaneous lumber.
5. Plywood backing panels.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.
 4. WCLIB: West Coast Lumber Inspection Bureau.
 5. WWPA: Western Wood Products Association.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Dimension Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWP U1, Use categories as follows:

1. UC1: Interior construction not in contact with ground or subject to moisture. Include the following items:
 - a. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - c. Wood floor plates that are installed over concrete slabs-on-grade.
2. UC3A (All Other Commodity Specifications): Coated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles but protected from liquid water. Include the following items:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
3. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all rough carpentry unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive

combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
 6. Grounds.
- B. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.
- C. 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.
- D. 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 are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction as appropriate for the substrate.

2.7 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- B. 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

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, 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.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. 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.
- G. 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.
- H. Comply with AWP A 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.

- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 - 3. ICC-ES evaluation report for fastener.
- K. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- 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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.
- D. 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 INSTALLATION OF WOOD FURRING

- 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.

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.

END OF SECTION 061000

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Paneling.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.
3. Section 099300 "Staining and Transparent Finishing" for finishing of interior finish carpentry.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.
- C. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors 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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
- B. Samples for Verification:
1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
 2. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber, mark grade stamp on end or back of each piece.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.
- D. MDF: ANSI A208.2, Grade 130.
- E. Particleboard: ANSI A208.1, Grade M-2.

2.2 INTERIOR TRIM

- A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):
1. Species and Grade: Red oak; NHLA Clear.
 2. Maximum Moisture Content: 10 percent.
 3. Finger Jointing: Not allowed.
 4. Gluing for Width: Not allowed.

5. Veneered Material: Use for lumber trim wider than 6 inches (150 mm).
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

B. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade:
 - a. Yellow poplar; NHLA A Finish.
2. Maximum Moisture Content for Softwoods: 15 percent.
3. Maximum Moisture Content for Hardwoods: 10 percent.
4. Finger Jointing: Not allowed.
5. Face Surface: Surfaced (smooth).
6. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

2.3 PANELING

- A. Grade: Premium.
- B. Wood Species and Cut: Plain-sliced red oak.
- C. Veneer Matching Method:
 1. Adjacent Veneer Leaves: Book.
 2. Within Panel Face: Balance match.
- D. Panel Matching Method:
 1. No matching is required between adjacent panels. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
- E. Panel Core Construction. Hardwood veneer core plywood; thickness 3/4 inch.
- F. Exposed Panel Edges: Inset solid-wood matching faces.
- G. Assemble panels by gluing and concealed fastening.
- H. Transparent Finish provided according to Section 099300 "Staining and Transparent Finishing".

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- C. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.

- D. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

2.5 FABRICATION

- A. Back out or kerf backs of the following members, except those with ends exposed in finished work:
 - 1. Interior standing and running trim, except shoe and crown molds.
 - 2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.
 - 1. Use concealed shims where necessary for alignment.
 - 2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
 - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 INSTALLATION OF INTERIOR TRIM

- A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.
 - 1. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
 - 6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
 - 7. Install trim after gypsum-board joint finishing operations are completed.
 - 8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
 - 9. Fasten to prevent movement or warping.
 - 10. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 INSTALLATION OF PANELING

- A. Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.
 - 1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
 - 2. Install with uniform tight joints between panels.
 - 3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
 - 4. Space fasteners and adhesive as recommended by panel manufacturer.
 - 5. Conceal fasteners to greatest practical extent.
 - 6. Arrange panels with grooves and joints over supports.
 - a. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.
 - b. Use fasteners with prefinished heads matching groove color.

3.6 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements.
 - 1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
- B. Adjust joinery for uniform appearance.

3.7 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces.
- B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.8 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Spray-applied cellulosic insulation.
 - 2. Insulation for miscellaneous voids
- B. Related Requirements:
 - 1. Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.
 - 2. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
 - 1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
 - 2. Sign, date, and post the certification in a conspicuous location on Project site.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Spray-Applied Open Cell Medium Density Foam Insulation: Fast set, open-cell, 100 percent water-blown spray polyurethane foam insulation.
 - 1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
 - 2. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
 - 3. Vapor-Permeable: 3.6 perms when tested in accordance with ASTM E96.
 - 4. Density: 1.3 lbs. per cubic foot.
- B. Available Manufacturers and Products: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Envirofoam of America LLC; Envirofoam Medium Density Spray Insulation.

2.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
 - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 - 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
 - 3. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Install insulation with manufacturer's R-value label exposed after insulation is installed.
- D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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SECTION 072129 – SPRAY APPLIED CELLULOSE ACOUSTICAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Spray-applied cellulose acoustical insulation.

B. Related Items

1. Clips, hangers, supports, sleeves and other attachments to spray bases are to be placed by other trades prior to the application of sprayed insulation.
2. Ducts, piping, conduit or other suspended equipment shall not be positioned until after the application of sprayed insulation.
3. Roof penetrations to be installed prior to application.

1.2 QUALITY ASSURANCE

A. Manufacturer must have a current Underwriters Laboratories (UL) Code Evaluation Report.

B. Manufacturer must be in compliance with the International Building Code, current version.

C. Manufacturer must be ISO 9001:2015 Certified.

D. Applicator: Licensed by manufacturer.

E. Manufacturer must subscribe to independent laboratory follow-up inspection services of Underwriters Laboratories and Factory Mutual. Each bag shall be labeled accordingly.

F. Mock-up: Apply a 100 square foot representative sample to be reviewed by the Architect and/or Owner prior to proceeding.

1.3 SUBMITTALS

A. Submit product data that the product meets or exceeds the following specified requirements.

1. Bond strength shall be greater than 100 psf per ASTM E 736.
2. Product shall be Class 1 Class A per ASTM E 84/ UL 723.
3. Non-corrosive per ASTM C 739.
4. Bond Deflection per ASTM E 759: 6" Deflection in 10' Span – No Spalling or Delamination.
5. R-Value to be 3.75 per inch per ASTM C 518.
6. Comply with 2009 IBC Section 803.10 stability requirements for interior finishes.
7. Meet ASTM C 1149

B. Manufacturer's written certification that product contains no asbestos, fiberglass or other man-made mineral fibers.

C. Copy of manufacturer's ISO 9001:2015 Certification.

- D. Minimum Fiber Recycled Content to be 75%.
- E. Cannot contain any added Urea-Formaldehyde Resins.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver in original, unopened containers bearing name of manufacturer, product identification and reference to U.L. testing.
- B. Store materials dry, off ground, and under cover.
- C. Protect liquid adhesive from freezing.
- D. Water to be potable.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS: Surface-Burning Characteristics: Comply with ASTM E84, Class 1, Class A; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- A. Flame-Spread Index: 5.
- B. Smoke-Developed Index: 5.

2.2 MANUFACTURERS: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- A. International Cellulose Corporation, www.spray-on.com.
- B. For approved applicators contact ICC at 800-444-1252.

2.3 MATERIALS

- A. Spray Applied Acoustical Insulation: K-13 Sound Absorption Spray:
 - 1. Color shall be from manufacturer's standard color chart.
 - 2. Comply with local Building Code requirements.
 - 3. Material to have been tested in accordance with ASTM E 1042. Testing laboratory must be NVLAP accredited.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and report unsatisfactory conditions in writing. Do not proceed until unsatisfactory conditions are corrected.
- B. Verify surfaces to receive spray insulation to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains.

3.2 PREPARATION

- A. Provide masking, drop cloths or other satisfactory coverings for materials/surfaces that are not to receive insulation to protect from over-spray.
- B. Coordinate installation of the sprayed cellulose fiber with work of other trades.
- C. Prime surfaces as required by manufacturer's instructions or as determined by examination.

3.3 INSTALLATION

- A. Install spray applied insulation according to manufacturer's recommendations.
- B. Install spray applied insulation to achieve an average R-Value of 15.
- C. Install spray applied insulation to achieve an average NRC of 1.00.

K-13 Sprayed Thermal and Acoustical Insulation ASTM C-423 on Solid Backing							
Inches	125 HZ	250 HZ	500 HZ	1000 HZ	2000 HZ	4000 HZ	NRC
1"	0.11	0.32	0.84	0.99	1.01	0.98	0.80
1.75"	0.30	0.74	1.14	1.06	0.99	0.98	1.00
2"	0.47	0.90	1.06	1.06	1.08	1.07	1.00
3"	0.57	0.99	1.04	1.03	1.00	0.98	1.00
4"	0.84	1.06	1.01	1.03	1.00	0.98	1.05
5"	0.99	0.89	1.05	1.03	1.00	1.00	1.00

- D. Cure insulation with continuous natural or mechanical ventilation.
- E. Remove and dispose of over-spray.

3.4 PROTECTION

- A. Protect finished installation under provision of Division 1.

END OF SECTION 072129

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SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Base sheet materials.
2. Interply sheets.
3. Styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.
4. Roof coating
5. Base flashing sheet materials.
6. Asphalt materials.
7. Accessory roofing materials.
8. Substrate board.
9. Vapor retarder.
10. Roof insulation.
11. Insulation accessories and cover board.

B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for metal low-slope roof flashings and counterflashings.

1.2 DEFINITIONS

- ##### A. Roofing Terminology:
- Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

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

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Base sheet materials.
2. Interply sheets.
3. Styrene-butadiene-styrene (SBS)-modified bituminous cap sheet.
4. Roof coating
5. Base flashing sheet materials.
6. Asphalt materials.
7. Accessory roofing materials.
8. Substrate board.
9. Vapor retarder.
10. Roof insulation.
11. Insulation accessories and cover board.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Crickets, saddles, and tapered edge strips, including slopes.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Cap Sheet: Samples of manufacturer's standard colors for selection by Architect.
2. Flashing Sheet: Samples of manufacturer's standard colors for selection by Architect.
3. Base sheet, vapor retarder sheet, and interply sheet.
4. Samples of manufacturer's roof coating colors for selection by Architect.

D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. and Roofing Inspector. Include letter from Manufacturer written for this project indicating approval.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - a. Submit evidence of complying with performance requirements.
 - b. Indicate that proposed system components are compatible.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- C. Product Test Reports: For roof membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.
- D. Evaluation Reports: For components of membrane roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty. Installer shall provide for the project a full-time on-site supervisor with a minimum of five years experience installing similar work and qualified by the manufacturer.
- C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
 - a. An authorized full-time technical employee of the manufacturer.
 - b. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute, retained by the Contractor or the Manufacturer and approved by the Manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
 1. Protect stored liquid material from direct sunlight.
 2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.
 - 1. Store in a dry location.
 - 2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, vapor retarder, substrate board, and other components of roofing system.
 - 2. Warranty Period: 20 years from date of Substantial Completion.
 - 3. Indicate a wind speed warranty of 90 M.P.H., as reported by the certified weather reporting station nearest to the site for the West Point, N.Y. region.
 - 4. Provide a sample copy of standard roofing manufacturer's warranty, stating obligations, remedies, limitations, and exclusions of warranty
- B. Applicator/Roofing Contractor Warranty: Submit roofing installer's written warranty, signed by the installer, covering work of this section, including but not limited to, roof plies and adhesive, insulation layers, base flashings, roof insulations, wood components, fasteners, and all roof system metal components for two years from the date of substantial completion. The warranty shall guarantee material and workmanship for watertightness, weathertightness, and against all leaks. During the two-year period, the contractor shall respond and fix all reported leaks within 24 hours from time of notification, and fix all leaks without any cost to the Owner.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.
- B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

- C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
 - 1. Fire/Windstorm Classification: Class 1A-90.
 - 2. Hail-Resistance Rating: FM 1-34 SH.
- D. Energy Performance: Roofing system to have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested in accordance with ANSI/CRRC S100.
- E. Energy Star Listing: Roofing system to be listed on the DOE's Energy Star "Roof Products Qualified Product List" for low-slope roof products.
- F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency.
 - 1. Identify products with appropriate markings of applicable testing agency.
- G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.
 - 1. Identify products with appropriate markings of applicable testing agency.

2.2 STYRENE-BUTADIENE-STYRENE (SBS)-MODIFIED BITUMINOUS MEMBRANE ROOFING

- A. Styrene-Butadiene-Styrene (SBS)-Modified Bituminous Membrane Roof System: See the following articles for individual roof materials required.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco Incorporated; SBS Modified Bitumen Roof System or a comparable product by one of the following:
 - a. Henry Company.
 - b. Siplast, Inc.
 - c. Soprema, Inc.

2.3 SOURCE LIMITATIONS

- A. Obtain all components for roof system from roof membrane manufacturer.

2.4 VAPOR RETARDER, BASE AND INTERPLY SHEET MATERIALS

- A. Asphalt-Coated, Glass-Fiber-Mat Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.
 - 1. Weight: 25 lb/100 sq. ft. (1.2 kg/sq. m), minimum.
 - 2. Basis-of-Design Product: TREMCO BURmastic Modified Composite Ply.

2.5 STYRENE-BUTADIENE-STYRENE (SBS)-MODIFIED BITUMINOUS CAP SHEET

- A. SBS-Modified Bitumen Type III, Polyester- and Glass-Fiber-Mat, Granule-Surfaced Cap Sheet: ASTM D6162/D6162M, Type III, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester fabric and glass fibers, suitable for cold adhesive method.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco Incorporated; TREMCO POWERply Premium FR (all new roof areas)
 - 2. Where required for patches at existing SBS-modified asphalt membrane roofing, provided roofing cap sheet materials recommended by the manufacturer.
 - 3. Granule Color: Light colored to match existing.

2.6 ROOF COATING

- A. Roof coating meeting energy requirements and to match existing roof appearance, as recommended by roofing manufacturer.

2.7 BASE FLASHING SHEET MATERIALS

- A. Basis of Design: Subject to compliance with requirements, provide TREMCO Hypalon Elastomeric Sheeting.
- B. Where required for transitions to existing SBS-modified asphalt membrane roofing areas, provided base flashing sheet materials recommended by the manufacturer.
- C. Cold Fluid-Applied Elastomeric Flashing Adhesive: One-part, asbestos-free, cold-applied, SEBS/SIS-based, elastomeric trowel-grade adhesive specially formulated for compatibility and use with specified roofing membranes and flashings.

2.8 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Contact Adhesives: 80 g/L.
 - f. Other Adhesives: 250 g/L.
 - g. Nonmembrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.

3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Cold-Applied Trichloroethylene Asphalt Adhesive: ASTM D3019, Type III, roof membrane manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane and base flashings.
- C. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with interply sheets and aggregate surfacing adhesive.
- D. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.
- E. Asphalt Primer: ASTM D 41/D 41M.
- F. Water-Based Asphalt Primer: Water-based, asbestos-free, polymer modified, asphalt primer.
 1. Basis-of-Design Product: TREMCO TREMprime WB.
- G. Elastomeric Roofing Mastic: One-part, asbestos-free, trowel-grade, elastomeric roof mastic specially formulated for compatibility and use with specified roofing membranes and flashings, with the following properties:
 1. Elongation at 77 deg. F, minimum, ASTM D 412: 1000 percent.
 2. Basis-of-Design Product: TREMCO POLYroof LV.
- H. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.
- I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- J. Metal Flashing Sheet: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- K. Lead Flashings: Plumbing stacks and Drain Bowls: 4 lb. sheets ASTM B29-79.
- L. Termination Bar: 0.060-inch thick aluminum bar, 2-inches wide by 10 foot lengths, with fastener spacing at 8-inches on center.
- M. Gasket Sealant: Two sided, butyl adhesive, 1-inch by 1/8-inch compression tape for termination bars.
 1. Basis-of-Design Product: TREMCO TremFlash (TF) Tape.
- N. Pitch Pocket Mastic: Pitch pocket sealer.
 1. Basis-of-Design Product: TremSEAL Pitch Pocket Sealer.
- O. Glass-Fiber Fabric for Stripping: Vinyl-coated glass-fiber mesh cloth.
 1. Basis-of-Design Product: TREMCO BURmesh.

- P. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.9 SUBSTRATE BOARD

- A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.
1. Basis of Design Product: TREMCO/GP Gypsum Dens-Deck.
 2. Thickness: 1/2 inch (13 mm).
 3. Surface Finish: Factory primed.
- B. Substrate Board Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.10 ROOF INSULATION

- A. General: Preformed roof insulation boards, manufactured by roof membrane manufacturer,.
- B. Closed Cell Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
1. Basis of Design: Subject to compliance with requirements, provide TREMCO Trisotech Isocyanurate Roof Insulation Board.
 2. Compressive Strength: 20 psi (138 kPa).
 3. Thickness: As indicated on drawings
- C. Tapered Insulation: Provide factory-tapered insulation boards.
1. Material: Match roof insulation.
 2. Minimum Thickness: 1/4 inch (6 mm).
 3. Slope:
 - a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
 - b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.
 4. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated

2.11 INSULATION ACCESSORIES AND COVER BOARD

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended solvent-free, cold fluid-applied, bituminous-urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer .

- D. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry."
- E. Tapered Edge Strips: ASTM C728, perlite insulation board or ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
- F. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
 - 1. Basis of Design Product: TREMCO/GP Gypsum Dens-Deck
 - 2. Thickness: 1/2 inch (13 mm).
 - 3. Surface Finish: Factory primed.
- G. Substrate Joint Tape: 6- or 8-inch- (150- or 200-mm-) wide, coated, glass fiber.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
 - 4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.
 - 1. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
 - 1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

- A. Install roofing membrane, base flashings, wood cants, blocking, curbs, and nailers, and component materials in compliance with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system as listed in FMG's "Approval Guide" for fire/windstorm classification indicated. Comply with

recommendations in FMG Loss Prevention Data Sheet 1-49, including requirements for wood nailers and cants.

- B. Install roofing system in accordance with roofing system manufacturer's written instructions.
- C. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF SUBSTRATE BOARD

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered in adjacent rows.
 - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
 - a. Locate end joints over crests of steel roof deck.
 - 2. Tightly butt substrate boards together.
 - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 4. Fasten substrate board to top flanges of steel deck in accordance with recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.

3.5 INSTALLATION OF VAPOR RETARDER

- A. Built-Up Vapor Retarder: Install two glass-fiber felt plies lapping each felt 19 inches (483 mm) over preceding felt.
 - 1. Embed each felt in a solid mopping of hot roofing asphalt.
 - 2. Glaze coat completed surface with hot roofing asphalt.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Nailer Strips: Mechanically fasten 4-inch nominal- (89-mm actual-) width, wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:
 - 1. 16 feet (4.88 m) apart for roof slopes greater than 1 inch per 12 inches (1:12) but less than 3 inches per 12 inches (3:12).
- D. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.

- E. Install tapered insulation under area of roofing to conform to slopes indicated.
- F. Install insulation with long joints of insulation in a continuous straight line, with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- H. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- I. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- J. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
 - 1. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines, with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction.
 - 1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
 - 2. At internal roof drains, conform to slope of drain sump.
 - a. Trim cover board, so that water flow is unrestricted.
 - 3. Cut and fit cover board tight to nailers, projections, and penetrations.
 - 4. Adhere cover board to substrate using adhesive in accordance with FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
 - a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.8 INSTALLATION OF ROOFING MEMBRANE, GENERAL

- A. Install roofing system in accordance with roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Where roof slope exceeds 1/2 inch per 12 inches (1:24) contact membrane manufacturer for installation instruction regarding installation direction.

- D. Coordinate installation of roofing system so insulation and other components of the roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
 - 1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt, with joints and edges sealed.
 - 2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
 - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.9 INSTALLATION OF BASE SHEET

- A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.
- B. Installation of Base Sheet:
 - 1. Install base sheet in accordance with roofing manufacturer's written instructions, starting at low point of roofing system.
 - 2. Extend roofing sheets over and terminate above cants.
 - 3. Adhere to substrate in a uniform coating of cold-applied adhesive.

3.10 INSTALLATION OF INTERPLY SHEETS

- A. Install three ply sheets, starting at low point of roofing.
 - 1. Align ply sheets without stretching.
 - 2. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane.
 - a. Shingle in direction to shed water.
 - 3. Extend ply sheets over and terminate above cants.

3.11 INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

- A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.
- B. Install modified bituminous roofing cap sheet in accordance with roofing manufacturer's written instructions, starting at low point of roofing system.
 - 1. Extend cap sheet over and terminate above cants.
 - 2. Install cap sheet in a shingle fashion.
 - 3. Install cap sheet as follows:
 - a. Adhere to substrate in cold-applied adhesive.
 - 4. Install cap sheet without wrinkles or tears, and free from air pockets.
 - 5. Install cap sheet so side and end laps shed water.

3.12 INSTALLATION OF FLASHING AND STRIPPING

- A. Install base flashing over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates in accordance with roofing system manufacturer's written instructions and as follows:
 - 1. Prime substrates with asphalt primer if required by roofing system manufacturer.
 - 2. Flashing Sheet Application, Cold: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
- B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane unless indicated otherwise on Drawings.
- C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
 - 1. Seal top termination of base flashing a metal termination bar.
- D. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing in accordance with roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch- (760-by-760-mm-) 4-pound (1.8 kg) lead flashing in bed of asphaltic adhesive on completed roofing membrane.
 - 1. Cover lead flashing with roofing cap-sheet stripping, and extend a minimum of 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane.
 - 2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
 - 3. Install stripping in accordance with roofing system manufacturer's written instructions.

3.13 ROOF COATING INSTALLATION

- A. Apply coating to roofing membrane according to manufacturer's written instructions, by spray, roller, or other suitable application method to provide a dry film thickness of not less than 20 mils.

3.1 FIELD QUALITY CONTROL

- A. Roofing Inspector: Contractor shall engage a qualified roofing inspector for a minimum of seven full-time days on site to perform roof tests and inspections and to prepare start up, interim, and final reports. Roofing Inspector's quality assurance inspections shall comply with criteria established in ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."
- B. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:
 - 1. Determine approximate quantities of components within roofing membrane according to ASTM D 3617.
 - 2. Examine test specimens for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

3. Repair areas where test cuts were made according to roofing system manufacturer's written instructions.
 - C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
 1. Notify Architect and Owner 48 hours in advance of date and time of inspection.
 - D. Roofing system will be considered defective if it does not pass tests and inspections.
 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.
- 3.2 PROTECTING AND CLEANING
- A. Protect roofing system from damage and wear during remainder of construction period.
 1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
 - B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.
 - C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Low-slope roof sheet metal fabrications.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 042000 "Unit Masonry" for materials and installation of manufactured sheet metal through-wall flashing and trim integral with masonry.

1.2 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counter-flashings.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Evaluation Reports: For copings and roof edge flashing, from ICC-ES showing compliance with ANSI/SPRI/FM 4435/ES-1.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.
 1. Source Limitations: Obtain sheet from single source from single manufacturer.
 2. Non-patinated, Exposed Finish: Mill.
- C. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 1. As-Milled Finish: Mill.

2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
 2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
 3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- C. Solder:
 1. For Copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead with maximum lead content of 0.2 percent.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- H. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.
- I. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Heckmann Building Products, Inc.
 - b. Hohmann & Barnard, Inc.
 - 2. Source Limitations: Obtain reglets from single source from single manufacturer.
 - 3. Material: Stainless steel, 0.0188 inch (0.477 mm) thick.
 - 4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - 5. Finish: Mill.

2.4 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
 - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
 - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
 - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
 - 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- G. Seams:
 - 1. Seams for Copper Sheet: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 - 2. Seams for Aluminum Sheet: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- H. Do not use graphite pencils to mark metal surfaces.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Materials:
 - 1. Existing Roofing System: Use copper sheet to match existing low-slope sheet metal fabrications where needed to tie in new roofing areas.
 - 2. New Roofing System at Elevator, Equipment Curbs, Duct Penetrations, etc.: Use aluminum sheet.
- B. Roof Edge Flashing (Gravel Stop), Coping, and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates.
 - 1. Joint Style: Overlapped, 4 inches (100 mm) wide.
 - 2. Fabricate from the following materials:
 - a. Copper: 20 oz./sq. ft. (0.68 mm thick).
 - b. Aluminum: 0.050 inch (1.27 mm) thick.
- C. Base Flashing: Fabricate from the following materials:
 - 1. Copper: 20 oz./sq. ft. (0.68 mm thick).
 - 2. Aluminum: 0.040 inch (1.02 mm) thick.
- D. Counterflashing: Fabricate from the following materials:
 - 1. Copper: 16 oz./sq. ft. (0.55 mm thick).
 - 2. Aluminum: 0.032 inch (0.81 mm) thick.
- E. Flashing Receivers: Fabricate from the following materials:
 - 1. Copper: 16 oz./sq. ft. (0.55 mm thick).
 - 2. Aluminum: 0.032 inch (0.81 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder or sealant.
 - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 - 5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
 - 6. Space individual cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 - 8. Do not field cut sheet metal flashing and trim by torch.
 - 9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
 - 1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
 - 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
 1. Pretin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pretinning where pretinned surface would show in completed Work.
 2. Do not solder aluminum sheet.
 3. Do not use torches for soldering.
 4. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
 5. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard.
 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
 2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches (100 mm) over base flashing.
3. Lap counterflashing joints minimum of 4 inches (100 mm).
4. Secure in waterproof manner.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 INSTALLATION OF MISCELLANEOUS FLASHING

A. Equipment Support Flashing:

1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

3.5 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.7 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

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SECTION 077200 - ROOF ACCESSORIES

1.1 SUMMARY

A. Section Includes:

1. Roof walkways.

B. Related Requirements:

1. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
3. Section 237300 "Packaged Rooftop Units" for curbs specified with rooftop units.

1.2 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.

1.3 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, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Delegated Design Submittals: For walkways, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Provide calculated loads and show point and distributed load locations.
2. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
3. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
1. Size and location of roof accessories specified in this Section.
 2. Method of attaching roof accessories to roof or building structure.
 3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
 4. Required clearances.

PART 2 - RODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories to 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.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design roof walkways to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: Design to meet special wind speed region requirements indicated on Drawings.

2.2 ROOF WALKWAYS

- A. Roof Walkway: Metal planking formed from multiple C-shaped channels with upper surface punched in serrated diamond or rectangular shapes to produce raised slip-resistant surface and drainage holes. Provide support framing, brackets, connectors, nosings, and other accessories and components needed for complete installation.
1. Include step units or stairs of similar construction for changes in elevation. Comply with ASCE-7, 29 CFR 1910.23, and requirements of authorities having jurisdiction.
 2. Equip walkways with safety railings where required.
 3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-line; brand of Eaton, Electrical Sector.
 - b. MIRO Industries.
 - c. PHP Systems/Design.
 4. Plank Width: As selected for delegated design.
 5. Walkway Width: As indicated.
 6. Channel Depth: As selected for delegated design.
 7. Metal Material: zinc-coated (galvanized) steel sheet, thickness as selected for delegated design, perforated, with serrated slip-resistant walking surface.
 8. Support Stands: Manufacturer's standard, with protective pads compatible with roofing material.

9. Wind Restraint: Provide wind restraint attachment to roof structure of size and spacing required to meet wind uplift requirements.
10. Finish: Manufacturer's standard.

2.3 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.
- B. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.
- C. Steel Tube: ASTM A500/A500M, round tube.
- D. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- E. Steel Pipe: ASTM A53/A53M, galvanized.

2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- C. Underlayment:
 1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D4397.
 3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
 4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
- E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.
- G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

- H. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. 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.
 - 1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Walkway Installation:
 - 1. Verify that locations of access and servicing points for roof-mounted equipment are served by locations of roof walkways.
 - 2. Remove ballast from top surface of low-slope roofing at locations of contact with roof-walkway supports.
 - 3. Install roof walkway support pads prior to placement of roof walkway support stands onto low-slope roofing.
 - 4. Redistribute removed ballast after installation of support pads.
- D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

- B. Clean exposed surfaces according to manufacturer's written instructions.
- C. Clean off excess sealants.
- D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Immersible joint sealants.
4. Mildew-resistant joint sealants.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

1.5 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.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 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.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation - Building Components.
 - c. The Dow Chemical Company.
 - d. Tremco Incorporated.
 2. Joint Sealant Schedule Type: JS-S2.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik; Arkema.
 - b. Pecora Corporation.
 - c. Sherwin-Williams Company (The).
 - d. Sika Corporation - Building Components.

- e. Tremco Incorporated.
 - B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Polymeric Systems, Inc.
 - c. Sherwin-Williams Company (The).
- 2.5 IMMERSIBLE JOINT SEALANTS
- A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C1247; tested in deionized water unless otherwise indicated.
 - B. Urethane, Immersible, S, P, 25, T, NT, I: Immersible, single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T, NT, and I.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Tremco Incorporated.
 - b. W. R. Meadows, Inc.
- 2.6 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: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sika Corporation - Building Components.
 - c. The Dow Chemical Company.
 - d. Tremco Incorporated.
- 2.7 LATEX JOINT SEALANTS
- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Pecora Corporation.
 - b. Sherwin-Williams Company (The).

- c. Tremco Incorporated.

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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), 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 joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. 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. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of 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 in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
 - 4. Provide flush joint profile at locations and applications in accordance with Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at locations in accordance with Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion [**Type: JS-S1**].
 - 1. Joint Locations:
 - a. Joints in pedestrian plazas.

2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces [**Type: JS-S2**].
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces [**Type: JS-S3**].
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 2. Joint Sealant: Urethane, S, P, 25, T, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces [**Type: JS-S4**].
1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Vertical joints on exposed surfaces of walls and partitions.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement [**Type: JS-S5**].
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.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces [**Type: JS-S6**].
1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

- b. Tile control and expansion joints where indicated.
- 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
- 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical joint sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Acoustical joint sealants.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

C. Acoustical Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

PART 2 - PRODUCTS

2.1 ACOUSTICAL JOINT SEALANTS

A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.

B. Acoustical Sealant for Exposed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hilti, Inc.
 - b. Pecora Corporation.
 - c. Tremco Incorporated.

- d. USG Corporation.
- 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hilti, Inc.
 - b. Pecora Corporation.
 - c. Tremco Incorporated.
 - d. USG Corporation.

2.2 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning

methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of acoustical joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect acoustical joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079219

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SECTION 080314 - HISTORIC TREATMENT OF WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Historic treatment of wood doors in the form of the following:
 - a. Repairing wood doors and trim.
 - b. Repairing, refinishing, and replacing hardware.

1.2 DEFINITIONS

- A. Door: Generally, this term includes door frame, leaves, hardware, side panels or lights, fan light, transom, storm and screen doors, and storm vestibule unless otherwise indicated by context.
- B. Glazing: Includes glass, glazing points, glazing tapes, glazing sealants, and glazing compounds.
- C. Wood Door Component Terminology: Wood door components for historic treatment work include the following classifications:
 1. Frame Components: Head, jambs, stop, and threshold or sill.
 2. Leaf Components: Stiles, rails, and muntins.
 3. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.
 4. Interior Trim: Casing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.
- B. Samples for Verification: Actual sample of finished products for the following, in manufacturer's standard sizes unless otherwise indicated:
 1. Refinished Wood Door Members: Prepare Samples using existing wood door members removed from site, repaired, and refinished.
 2. Weather Stripping: 12-inch- (300-mm-) long sections.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Pack, deliver, and store products in suitable packs, heavy-duty cartons, or wooden crates; surround with sufficient packing material to ensure that products will not be deformed, broken, or otherwise damaged.

- B. Store products inside a well-ventilated area, protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity, and where environmental conditions comply with manufacturer's requirements.

1.5 FIELD CONDITIONS

- A. Weather Limitations: Proceed with historic treatment of wood doors only when existing and forecasted weather conditions are within environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD DOORS QUALITY STANDARD

- A. Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWMAC/WI's "North American Architectural Woodwork Standards" for construction, finishes, grades of wood doors, and other requirements unless otherwise indicated.
 - 1. Exception: Industry practices cited in Section 12, Paragraph 6, "Industry Practices," under Article 12.1, "Basic Considerations," of AWMAC/WI's "North American Architectural Woodwork Standards" do not apply to the Work of this Section.

2.2 WOOD-REPLACEMENT MATERIALS

- A. Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide.
 - 1. Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

2.3 WOOD-REPAIR MATERIALS

- A. Source Limitations: Obtain wood consolidant and wood-patching compound from single source from single manufacturer.
- B. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated because of weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.
- C. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound to be designed for filling voids in damaged wood materials that have deteriorated because of weathering and decay. Compound to be capable of filling deep holes and spreading to feather edge.

2.4 WEATHER STRIPPING

- A. Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when door is closed.
 - 1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.
 - a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C509.
 - b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C864.

2.5 MISCELLANEOUS MATERIALS

- A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; containing no boric acid.
- B. Cleaning Materials:
 - 1. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate, 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.
 - 2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.
- C. Paint remover: Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.
- D. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F (21 deg C), in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure conditions.
- E. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.
 - 1. Match existing fasteners in material and type of fastener unless otherwise indicated.
 - 2. Use concealed fasteners for interconnecting wood components.
 - 3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
 - 4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
 - 5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
 - 6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.
- F. Anchors, Clips, and Accessories: Fabricate anchors, clips, and door accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect adjacent materials from damage by historic treatment of wood doors.
- B. Clean wood doors and trim of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.
- C. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC TREATMENT OF WOOD DOORS, GENERAL

- A. Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from the door interior at 10 ft. (3 m) away.
- B. General: In treating historic items, disturb them as minimally as possible and as follows:
 - 1. Stabilize and repair wood doors to reestablish structural integrity and weather resistance while maintaining the existing form of each item.
 - 2. Remove coatings and apply borate preservative treatment before repair.
 - 3. Repair items in place where possible.
 - 4. Install temporary protective measures to protect wood door work that is indicated to be completed later.
 - 5. Refinish historic wood doors in accordance with Section 099300 "Staining and Transparent Finishing".
- C. Mechanical Abrasion: Where mechanical abrasion is needed for the Work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.
- D. Repair and Refinish Existing Hardware: Dismantle door hardware; strip paint, repair, and refinish it to match finish Samples; and lubricate moving parts just enough to function smoothly.
- E. Repair Wood Doors: Match existing materials and features, retaining as much original material as possible to perform repairs.
 - 1. Unless otherwise indicated, repair wood doors by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
 - 2. Where indicated, repair wood doors by limited replacement matching existing material.
- F. Protection of Openings: Where doors are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.
- G. Identify removed doors, frames, leaves, trim, and members with numbering system corresponding to door locations to ensure reinstallation in same location. Key doors, frames, leaves, trim, and members to Drawings showing location of each removed unit. Permanently label units in a location that will be concealed after reinstallation.

3.3 INSTALLATION OF WEATHER STRIPPING

- A. Install weather stripping for tight seal of joints as determined by preconstruction testing and demonstrated in mockup.

3.4 ADJUSTING

- A. Adjust existing and replacement operating leaves, screens, hardware, weather stripping, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.5 CLEANING AND PROTECTION

- A. Protect door surfaces from contact with contaminating substances resulting from construction operations. Monitor door surfaces adjacent to and below exterior concrete and masonry during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances contact door surfaces, remove contaminants immediately.
- B. Clean exposed surfaces immediately after historic treatment of wood doors. Avoid damage to coatings and finishes. Remove excess sealants, glazing and patching materials, dirt, and other substances.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 080314

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior hollow-metal doors and frames.

B. Related Requirements:

1. Section 081713 "Integrated Metal Door Opening Assemblies".
2. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
3. Section 131113 "Medium Isolation Sound Control Door Assemblies" for packaged, acoustically rated door and frame assemblies.
4. Section 133473 "High Isolation Sound Control Door Assemblies" for packaged, acoustically rated door and frame assemblies.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise 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 anchorages, joints, field splices, and connections.
7. 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.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (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:
 1. Ceco Door; AADG, Inc.; ASSA ABLOY.
 2. Curries, AADG, Inc.; ASSA ABLOY Group.
 3. Republic Doors and Frames; Allegion brand.
 4. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

2.3 INTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; ANSI/SDI A250.4, Physical Performance 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 0.032 inch (0.8 mm).
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
 - f. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-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 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. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.6 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 in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.7 STEEL FINISHES

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

PART 3 - EXECUTION

3.1 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. 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 ANSI/SDI A250.11 or NAAMM-HMMA 840.
 - 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.
 - 2. Fire-Rated Openings: Install frames in accordance with 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. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 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 ANSI/SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA as required by guide specification standards.

2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

3.3 REPAIR

- 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.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Division 13 Sections for " Sound Control Door Assemblies" for acoustic flush wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory-machining criteria.
5. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory finished and application requirements.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Special warranties.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
 - 2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during remainder of construction period.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.
 - 2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C.
 - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

2.4 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Masonite Architectural.
 - b. Oshkosh Door Company.
 - c. VT Industries, Inc.
 - 2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
 - 3. Architectural Woodwork Standards and ANSI/WDMA I.S. 1A Grade: Premium / Custom.
 - 4. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.
 - a. Species: Red oak or White oak to match existing original front entry doors.
 - b. Cut: Plain sliced (flat sliced).
 - c. Match between Veneer Leaves: Book match.
 - d. Assembly of Veneer Leaves on Door Faces: Balance match.
 - e. Pair and Set Match: Provide for doors hung in same opening.
 - f. Room Match:
 - 1) Provide door faces of compatible color and grain within each separate room or area of building.

5. Exposed Vertical and Top Edges: Same species as faces - Architectural Woodwork Standards edge Type A.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors:
 - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 475 lbf (2110 N) in accordance with WDMA T.M. 10.
6. Core for Non-Fire-Rated Doors:
 - a. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Door Face: 550 lbf (2440 N).
 - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf (2440 N).
7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
 - a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.5 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
 1. Wood Species: Same species as door faces.
 2. Profile: Manufacturer's standard shape.
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.6 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
1. Locate hardware to comply with DHI-WDHS-3.
 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
 3. Louvers: Factory install louvers in prepared openings.

2.7 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 2. Finish faces, all four edges, edges of cutouts, and mortises.
 3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Factory finish doors that are indicated on Drawings to receive transparent finish.
- D. Factory finish doors where indicated in schedules or on Drawings as factory finished.
- E. Transparent Finish:
1. Architectural Woodwork Standards and ANSI/WDMA I.S. 1A Grade: Premium / Custom.
 2. ANSI/WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane.
 3. Staining: Match Architect's sample.
 4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3.2 mm in 2400 mm).
 2. Anchor frames to anchors or blocking built in or directly attached to substrates.
 - a. Secure with countersunk, concealed fasteners and blind nailing.
 - b. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.
 - 1) For factory-finished items, use filler matching finish of items being installed.
 3. Install fire-rated doors and frames in accordance with NFPA 80.
 4. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 081713 - INTEGRATED METAL DOOR OPENING 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. Section includes integrated metal door-opening assemblies consisting of doors, metal frame, operating hardware, and accessories.
- B. Related Requirements:
 - 1. Section 081113 "Hollow Metal Doors and Frames" for hollow-metal doors and frames.
 - 2. Section 087100 "Door Hardware" for cylinders for integrated metal door-opening assemblies not specified in this Section.

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, fire-resistance ratings, smoke ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each integrated metal door-opening assembly 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. Details of each different wall opening condition.

5. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.

C. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).

D. Product Schedule: For integrated metal door-opening assemblies, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of integrated metal door-opening assembly, for tests performed by a qualified testing agency.
- B. Sample Warranty: For manufacturer's warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For integrated door assemblies, including hardware, to include in operation and maintenance manuals.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver integrated metal door-opening assemblies 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 integrated metal door assemblies 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.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace integrated metal door-opening assembly and components that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of hardware or other components.

- b. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.
- 2. Warranty Period:
 - a. Integrated Metal Door-Opening Assemblies: Five years from date of Substantial Completion.
 - b. Operating Hardware: 10 years from date of Substantial Completion.
 - c. Electrified Hardware: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Adams Rite Manufacturing Company, an ASSA ABLOY Group company.
 - 2. Syntegra, LLC.
 - 3. Total Door Systems (Basis of Design for Hardware).
- B. Source Limitations: Obtain integrated metal door-opening assemblies, including doors, frames and hardware, 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 and temperature-rise limits indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 2. Where pairs of doors are required, provide units tested and listed without overlapping astragals.
 - 3. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 250 deg F (121 deg C) above ambient after 30 minutes of standard fire-test exposure.

2.3 INTEGRATED METAL DOOR-OPENING ASSEMBLIES

- A. Construct integrated metal door-opening assemblies using hollow-metal doors and frames that comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, clearances, and as specified. Provide factory-installed hardware to the maximum extent practicable.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in door and frame schedule.
 - 1. Doors:
 - a. Type: As indicated in 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: Polystyrene.
- g. Fire-Rated Core: Manufacturer's standard core for fire-rated and temperature-rise-rated doors.

2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- b. Construction: Full profile welded.

2.4 INTEGRATED METAL DOOR-OPENING ASSEMBLY HARDWARE, GENERAL

- A. General: Provide integrated metal door-opening assembly hardware and integrated metal door-opening assembly hardware sets indicated in Part 3 "Integrated Metal Door-Opening Assembly Hardware Sets" Article for each integrated metal door-opening assembly, to comply with requirements in this Section.
 - 1. Integrated Metal Door-Opening Assembly Hardware Sets: Provide quantity, item, size, finish, or color indicated, as well as named manufacturers' products or products equivalent in function and comparable in quality to named products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 - 3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch; not more than 30 lbf (133 N) to set the door in motion; and not more than 15 lbf (67 N) to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- B. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of integrated metal door-opening assembly hardware are indicated in Part 3 "Integrated Metal Door-Opening Assembly Hardware Sets" Article. Products are identified by using hardware designations as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Integrated Metal Door-Opening Assembly Hardware Sets" Article.

2.5 ACCESSORIES

- A. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; listed and labeled for use with fire-alarm systems.

2.6 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 A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.8 FABRICATION

- A. 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. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

- B. Hardware Preparation: Prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with SDI A250.6, 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.

2.9 FINISHES

- A. Door Faces and Frames: Manufacturer's standard factory finish, color as selected by Architect.
- 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 that specified by referenced standards for the applicable units of hardware.
- C. Factory Finish for Steel: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
 - 1. Color and Gloss: Match Architect's sample.
- D. Hardware Finishes: Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

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.

3.2 INSTALLATION

- A. General: Install integrated metal door-opening assemblies 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 and NFPA 80.
 - 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. 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.
3. Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
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. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 2. Smoke-Control Doors: Install doors in accordance with NFPA 105.

3.3 CLEANING AND TOUCHUP

- A. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.

3.4 INTEGRATED METAL DOOR-OPENING ASSEMBLY HARDWARE SETS

- A. Hardware Set # ID-01 (90/180° Hold Open)

2 ea	Full Height Hinges	H-13 Rigidized	Factory Painted
2 ea	Full Height Latch Channel	L-11	Factory Painted
2 ea	Operating Pulls	M32	710 Dark Bronze Anodized
2 ea	Exit Device	PF200 (Flush Panic)	Insert to match skin
2 ea	Lock Mechanism	GFP01 Passage Function	710 Dark Bronze Anodized
1 ea	Closer	TDC96P	710 Dark Bronze Anodized
1 ea	Closer	TDC8907	710 Dark Bronze Anodized
2 ea	Mag Holder	TDH200	
2 ea	Smoke / Sound Gasket		Black
2 ea	Adjustable Mortise Sweep	TDS14A-01	
2 ea	Positive Pressure label (confirm rating with door schedule)		
	(Requires temperature rise rating)		

- B. Hardware Set # ID-02 (90° Hold Open)

2 ea	Full Height Hinges	H-13 Rigidized	Factory Painted
2 ea	Full Height Latch Channel	L-11	Factory Painted
2 ea	Operating Pulls	M32	710 Dark Bronze Anodized
2 ea	Exit Device	PF200 (Flush Panic)	Insert to match skin
2 ea	Lock Mechanism	GFP01 Passage Function	710 Dark Bronze Anodized
2 ea	Closer	TDC96P	710 Dark Bronze Anodized
2 ea	Mag Holder	TDH200	
2 ea	Smoke / Sound Gasket		Black
2 ea	Adjustable Mortise Sweep	TDS14A-01	
2 ea	Positive Pressure label (confirm rating with door schedule)		
	(Requires temperature rise rating)		

C. Hardware Set #ID-03 (Double Egress 90° Hold Open)

2 ea	Full Height Hinges	H-13 Rigidized	Factory Painted
2 ea	Full Height Latch Channel	L-11	Factory Painted
2 ea	Exit Device	PF200 (Flush Panic)	Insert to match skin
2 ea	Lock Mechanism	GFP01 Passage Function	710 Dark Bronze Anodized
2 ea	Closer	TDC96P	710 Dark Bronze Anodized
2 ea	Mag Holder	TDH200	
2 ea	Smoke / Sound Gasket		Black
2 ea	Adjustable Mortise Sweep	TDS14A-01	
2 ea	Positive Pressure label (confirm rating with door schedule)		
	(Requires temperature rise rating)		

END OF SECTION 081713

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Acoustically-rated access doors and frames.
 - 2. Fire-rated access doors and frames.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

- A. Recessed Acoustically-Rated Access Doors with Concealed Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Karp Associates, 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. Optional Features: Acoustical gasketing and continuous exposed stainless steel piano hinges.
 - 4. Locations: Ceiling.
 - 5. Door Size: As indicated.
 - 6. Metallic-Coated Steel Sheet for Door: 18 gage satin coat steel, recessed design filled with 1-1/2 inch thick acoustic mineral liner, 0.11 inch thick mineral filled vinyl barrier, and fitted with 5/8 inch thick drywall as finished face.
 - 7. Frame: 18 gage, press bent for strength and rigidity, drywall taping bead flange insulated with 1 inch thick acoustical mineral liner.
 - 8. Latch and Lock: Cam latch, screwdriver operated.

9. Acoustic Rating: Certified to STC Rating 64.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ACUDOR Products, Inc.
 - b. Babcock-Davis.
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. Optional Features: Concealed hinge.
4. Locations: Wall and ceiling.
5. Door Size: As indicated.
6. Fire-Resistance Rating: Not less than that of adjacent construction.
7. Temperature-Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
8. Metallic-Coated Steel Sheet for Door: Manufacturer's standard thickness required to meet fire-resistance rating, factory finished.
9. Frame Material: Same material, thickness, and finish as door.
10. Latch and Lock: Self-closing, self-latching door hardware, Cam latch, screwdriver operated.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- D. Frame Anchors: Same material as door face.
- E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

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:
 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

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.
 2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.
 - a. Color: As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

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

3.3 ADJUSTING

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

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulated service doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.

C. Samples for Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty and finish warranty

1.4 CLOSEOUT SUBMITTALS

A. Special warranty and finish warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Manufacturer's "Max Finish" warranty. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Sound-Control Doors: Assemblies tested in a laboratory for sound-transmission-loss performance according to ASTM E90, calculated according to ASTM E413, and rated for not less than the STC value indicated.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
 - 1. Design Wind Load: As indicated on Drawings but not less than 20 PSF.
 - 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
- C. Seismic Performance: Overhead coiling doors are to withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.3 DOOR ASSEMBLY

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide **Overhead Door Corporation Stormtite Insulated Door Model 625** or comparable product by one of the following:
 - a. ACME Rolling Doors.
 - b. Advanced Door Technologies.
 - c. City Gates USA.
 - d. Cornell; a CornellCookson company.
 - e. McKeon Door Company.

f. Metro Door LLC.

- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. (5.1 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E283 or DASMA 105.
- D. STC Rating: 21.
- E. Insulated Door Curtain R-Value: 7.7.
- F. Insulated Door Assembly U-Factor: 0.13.
- G. Door Curtain Material: Galvanized steel.
- H. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
 - 1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- I. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.
- J. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- K. Hood: Match curtain material and finish.
 - 1. Shape: Round.
 - 2. Mounting: Face of wall.
- L. Locking Devices: Equip door with locking device assembly.
 - 1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside and outside with cylinders.
- M. Manual Door Operator: Chain-hoist operator.
- N. Curtain Accessories: Equip door with weatherseals.
- O. Door Finish:
 - 1. Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
 - a. Basis of Design: 'PowderGuard Max Finish Complete Door System' by Overhead Door Corporation.

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise

indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A653/A653M.
- B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

2.6 LOCKING DEVICES

- A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
1. Lock Cylinders: As specified in Section 087100 "Door Hardware" and keyed to building keying system.

2.7 CURTAIN ACCESSORIES

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

2.8 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf (111-N) force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.10 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

3.4 DEMONSTRATION

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

END OF SECTION 083323

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

B. Related Requirements:

1. Section 085113 "Aluminum Windows" " for coordinating finish among aluminum fenestration units.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

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.

C. Samples for Selection: For units with factory-applied color finishes.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Delegated Design Submittal: For aluminum-framed entrances and storefronts including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Statements:

1. For Installer.

B. Delegated design engineer qualifications.

C. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrances and storefronts.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 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 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.

- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. 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 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
 - 1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).

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 in accordance with ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft..
- G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft. .
 2. Maximum Water Leakage: In accordance with AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- H. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
- I. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
 - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.38 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100.
 - b. Entrance Doors: U-factor of not more than 0.77 Btu/sq. ft. x h x deg F (4.37 W/sq. m x K) as determined in accordance with NFRC 100.
 2. Solar Heat-Gain Coefficient (SHGC):
 - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.38 as determined in accordance with NFRC 200.
 - b. Entrance Doors: SHGC of not more than 0.38 as determined in accordance with NFRC 200.
 3. Air Leakage:
 - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 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) when tested in accordance with ASTM E283.

- b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- 4. Condensation Resistance Factor (CRF):
 - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 68 as determined in accordance with AAMA 1503.
 - b. Entrance Doors: CRF of not less than 57 as determined in accordance with AAMA 1503.
- J. 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 STOREFRONT SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Tubelite Inc.; TU24000 SERIES STOREFRONT SYSTEM 2" x 4 1/2" (dual thermal barrier) or a comparable product by one of the following:
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 1. Exterior Framing Construction: Thermally broken.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: center set, 1-3/4" from exterior plane of storefront frame.
 - 4. Finish: High-performance organic finish.
 - 5. Fabrication Method: Field-fabricated stick system.
 - 6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 7. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Tubelite Inc.; TU24000 SERIES STOREFRONT SYSTEM 2" x 4 1/2" (dual thermal barrier) < > or a comparable product by one of the following:
- B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
 - 1. Door Construction: 1-3/4-inch (44.5-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: Wide stile.
 - a. Vertical stile: 6-inch (127-mm) nominal width.
 - b. Top Rail: 5"-inch
 - c. Bottom Rail: 10"-inch
 - 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
 - 4. Finish: Match adjacent storefront framing finish.
- 2.5 ENTRANCE DOOR HARDWARE
- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
 - B. Prepare doors for future access control system (latch release).
- 2.6 GLAZING
- A. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
 - B. Glazing Sealants: As recommended by manufacturer.
 - C. Insulating-Glass Units: ASTM E2190. Basis of Design: Basis of Design: Solarban60 (2) Clear + Clear with visible light transmittance of 70%
 - 1. Glass: ASTM C1036, Type 1, Class 1, q3.
 - a. Tint: Clear.
 - b. Kind: Fully tempered where indicated on Drawings and as required by Authorities Having Jurisdiction
 - 2. Filling: Fill space between glass lites with argon.
 - 3. Low-E Coating: Pyrolytic on second surface.
 - 4. Thickness: 1 inch.
- 2.7 MATERIALS
- A. Sheet and Plate: ASTM B209 (ASTM B209M).
 - B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
 - C. Structural Profiles: ASTM B308/B308M.
 - D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement 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 in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- 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 A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.
- E. Rigid PVC filler.

2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. 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 manufacturer's standard system. .
- F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- I. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.10 ALUMINUM FINISHES

- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - 1. Color: Dark bronze.

2.11 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.
- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.

- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Seal perimeter and other joints watertight unless otherwise indicated.
- G. 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.
- H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- I. Install joint filler behind sealant as recommended by sealant manufacturer.
- J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

- A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance 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 in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.5 ERECTION TOLERANCES

- A. 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.

3.6 MAINTENANCE SERVICE

A. Entrance Door Hardware Maintenance:

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.

END OF SECTION 084113

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes aluminum windows for exterior locations.
- B. Related Requirements:
 - 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
 - 1. Include plans, elevations, sections, hardware, accessories, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.
- D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Sample Warranties: For manufacturer's warranties.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports and calculations.
- B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Failure to meet performance requirements.
- b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
- c. Faulty operation of movable sash and hardware.
- d. Deterioration of materials and finishes beyond normal weathering.
- e. Failure of insulating glass.

2. Warranty Period:

- a. Window: 10 years from date of Substantial Completion.
- b. Glazing Units: 10 years from date of Substantial Completion.
- c. Aluminum Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.

- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: AW.
2. Minimum Performance Grade: 100.

- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F (1.71 W/sq. m x K).

- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.38 .

- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 71.

- F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.

2.3 ALUMINUM WINDOWS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide EFCO Corporation; **590X Fixed Aluminum 'Steel Replica Windows'** 3-1/4 system depth **AW-PG100-FW** or a comparable product by one of the following:
1. Kawneer Company, Inc.; Arconic Corporation.
 2. TRACO.
 3. Wausau Window and Wall Systems; Apogee Wausau Group, Inc.
- B. **Types:** Provide the following types in locations indicated on Drawings:
1. Fixed.
- C. **Frames and Sashes:** Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
1. **Thermally Improved Construction:** Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.
- D. **Insulating-Glass Units:** ASTM E2190.
1. **Glass:** ASTM C1036, Type 1, Class 1, q3. Basis of Design: Solarban60 on clear 6mm (2) | Air (10%) / Argon (90%) Mix 3/4" | 5mmClear_030PVB_5mmClear by Vitro Architectural Glass with Visible Light Transmittance = 69%.
 - a. Exterior Lite: 1/4" clear glass, sputter coated on the second surface.
 - b. Interior Lite: 3/8" laminated clear glass with 030PVB clear interlayer.
 2. **Thickness:** 1-3/8" (3/4" space between glass lites).
 3. **Filling:** Fill space between glass lites with argon.
 4. **Low-E Coating:** Pyrolytic on second surface.
- E. **Glazing System:** Manufacturer's standard factory-glazing system that produces weathertight seal.
- F. **Fasteners:** Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. **Exposed Fasteners:** Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

- A. **Dividers (False Muntins):** Provide extruded-aluminum divider grilles in designs indicated for each sash lite.
1. **Type:** Simulated True Divided Lite. Permanently located at exterior and interior lite and between insulating-glass lites.
 2. **Pattern:** As indicated on Drawings.
 3. **Profile:** As indicated on Drawings.

- B. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
- C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- D. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- E. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- F. Complete fabrication, assembly, finishing, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - 1. Color: Dark bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
 - 1. Keep protective films and coverings in place until final cleaning.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
 - 1. Door hardware for steel (hollow metal) doors.
 - 2. Door hardware for wood doors.
 - 3. Door hardware for other doors indicated.
 - 4. Keyed cylinders as indicated.
- B. Related Sections:
 - 1. Division 6: Rough Carpentry.
 - 2. Division 8: Aluminum Doors and Frames
 - 3. Division 8: Hollow Metal Doors and Frames.
 - 4. Division 8: Wood Doors.
 - 5. Division 26 Electrical
 - 6. Division 28: Electronic Security
- C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
 - 1. Builders Hardware Manufacturing Association (BHMA)
 - 2. NFPA 101 Life Safety Code
 - 3. NFPA 80 -Fire Doors and Windows
 - 4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
 - 5. UL10C – Positive Pressure Fire Test of Door Assemblies
 - 6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
 - 7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
 - 8. ICC – International Building Code
- D. Intent of Hardware Groups
 - 1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
 - 2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

1.2 SUBSTITUTIONS:

- A. Comply with Division 1.

1.3 SUBMITTALS:

- A. Comply with Division 1.

- B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.
- C. Product Data: Manufacturer's specifications and technical data including the following:
1. Detailed specification of construction and fabrication.
 2. Manufacturer's installation instructions.
 3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
 4. Submit 6 copies of catalog cuts with hardware schedule.
 5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2
- D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.
1. List groups and suffixes in proper sequence.
 2. Completely describe door and list architectural door number.
 3. Manufacturer, product name, and catalog number.
 4. Function, type, and style.
 5. Size and finish of each item.
 6. Mounting heights.
 7. Explanation of abbreviations and symbols used within schedule.
 8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.
- E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.
- F. Samples: (If requested by the Architect)
1. 1 sample of Lever and Rose/Escutcheon design, (pair).
 2. 3 samples of metal finishes
- G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
1. Operating and maintenance manuals: Submit 3 sets containing the following.
 - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 2. Copy of final hardware schedule, edited to reflect, "As installed".
 3. Copy of final keying schedule
 4. As installed "Wiring Diagrams" for each piece of hardware connected to power, both low voltage and 110 volts.
 5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years' experience in the distribution of commercial hardware.
 - a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
 - b. Hardware Schedule shall be prepared and signed by an AHC.
4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
 - a. Provide UL listed hardware for labeled and 20-minute openings in conformance with requirements for class of opening scheduled.
 - b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

- A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:

1. Closers: Ten years
2. Exit Devices: Five Years
3. Locksets & Cylinders: Three years
4. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION:

- A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

- A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.
1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
 2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
 3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.
- B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

<u>Item:</u>	<u>Manufacturer:</u>
Hinges	Stanley
Continuous Hinges	Stanley
Cylinders	Best
Exit Devices	dormakaba
Closers	dormakaba 8900
Pulls	Trimco
Protection Plates	Trimco
Overhead Stops	dormakaba
Door Stops	Trimco
Flush Bolts	Trimco

Coordinator & Brackets	Trimco
Threshold & Gasketing	National Guard

2.2 MATERIALS:

A. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Sufficient size to permit door to swing 180 degrees

Hinges:

Provide 4-1/2 inch by 4-1/2 inch size with non-removable pins for out swinging doors with locks unless otherwise specified. Provide non-rising pins elsewhere.

Provide number of hinges indicated but not less than three hinges per door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height.

Provide 5 inch by 4-1/2-inch hinges on doors greater than 3'0" in width.

Where wide throw hinges are specified in the hardware sets, provide proper hinge width for necessary clearance required.

B. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Fit ANSI A115.1 door preparation
5. Functions and design as indicated in the hardware groups
6. Solid, one-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
7. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel
8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
9. Auxiliary deadlatch to be made of one-piece stainless steel, permanently lubricated
10. Provide sufficient curved strike lip to protect door trim
11. Lever handles must be of forged or cast brass, bronze or stainless-steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
12. Lock shall have self-aligning, thru-bolted trim
13. Levers to operate a roller bearing spindle hub mechanism

14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
15. Spindle to be designed to prevent forced entry from attacking of lever
16. Provide locksets with 7-pin removable and interchangeable core cylinders
17. Each lever to have independent spring mechanism controlling it
18. Core face must be the same finish as the lockset.

C. Exit Devices:

1. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.
2. Exit devices to be tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
3. Exit devices chassis to be investment cast steel, zinc dichromate.
4. Exit devices to have stainless steel deadlocking $\frac{3}{4}$ " through latch bolt.
5. Exit devices to be equipped with sound dampening on touchbar.
6. Non-fire rated exit devices to have cylinder dogging.
7. Non-fire rated exit devices to have $\frac{1}{4}$ " minimum turn hex key dogging.
8. Touchpad to be "T" style constructed of architectural metal with matching metal end caps.
9. Touchbar assembly on wide style exit devices to have a $\frac{1}{4}$ " clearance to allow for vision frames.
10. All exposed exit device components to be of architectural metals and "true" architectural finishes.
11. Provide strikes as required by application.
12. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
13. The strike is to be black powder coated finish.
14. Exit devices to have field reversible handing.
15. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchsets.
16. Provide 9001-Quality Management and 14001-Environmental Management.
17. Vertical Latch Assemblies to have gravity operation, no springs.

D. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

E. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum $2 \frac{7}{16}$ inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with $1\frac{1}{2}$ " minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification

11. Closers shall be non-handed, non-sized and multi-sized.
- F. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.
1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
 2. Provide fastener suitable for wall construction.
 3. Coordinate reinforcement of walls where wall stop is specified.
 4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered
- G. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.
1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
 2. Surface overhead stops shall be heavy duty bronze or stainless steel.
- H. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- I. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- J. Door Bolts: Flush bolts for wood or metal doors.
1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
 2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
 3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
 4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.
- K. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
 2. Provide mounting brackets for soffit applied hardware.
 3. Provide hardware preparation (cutouts) for latches as necessary.
- L. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.
- M. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone)
 2. UL10C Positive Pressure rated seal set when required.
- N. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
 2. UL10C Positive Pressure rated seal set when required.

- O. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½" for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.
- P. Provide one wall mounted Telkee, Lund or MMF series key cabinet complete with hooks, index and tags to accommodate 50% expansion. Coordinate mounting location with architect.
- Q. Keystone Web Key Management Software: Provide one, Keystone Web product "KSWN" key management software. Shall include
 - 1. Configurable Password Policy for logins.
 - 2. User friendly interface - Tile Icons and Customizable dashboard.
 - 3. Easy Data Entry & Import to import/append data continuously.
 - 4. Active Directory synchronization to reduce manual entry.
 - 5. Configurable Email notifications for all keys and other items currently due back on a designated day, notifications when keys and items are issued, and notifications when keys and other items are returned.
 - 6. Global Search functionality capable of listing all cores and their location, building and doors.
 - 7. Cross-references people to cores and keys, doors, and buildings they access.
 - 8. Customizable Reports.
 - 9. Self-serve Password retrieval functionality.
 - 10. Program shall be standalone or network capable, LAN or WAN compatible.
 - 11. Flexibility: The software shall be capable of allowing an authorized user secure access to the software from anywhere, provided user can access their organization's secure network.
 - 12. Encrypted database and SQL server express backend.
 - 13. Software program is to be compatible with Windows 7 Professional 32/64 bit (Standalone PC). Windows 2008/2012 Server 32/64 bit.
 - 14. Browser Requirements: Internet Explorer 10 or greater Microsoft Edge browser latest Firefox or Chrome Internet browsers.
 - 15. Minimum Microsoft software Prerequisites: SQL Server 2014 Express or Greater. NET Framework 4.5 or greater.
- R. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.3 FINISH:

- A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products
- B. Powder coat door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

- A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

- B. Cylinders, removable and interchangeable core system: Best CORMAX™ Patented 7-pin.
- C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."
- D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.
- E. Furnish keys in the following quantities:
 - 1. 1 each Grand Masterkeys
 - 2. 4 each Masterkeys
 - 3. 2 each Change keys each keyed core
 - 4. 15 each Construction masterkeys
 - 5. 1 each Control keys
- F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.
- G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
 - 1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
 - 2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
 - 3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.

- C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
 - 1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.
- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.
 - 1. Check and adjust closers to ensure proper operation.
 - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
 - a. Verify levers are free from binding.
 - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.
 - 3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

SET #01 – each opening to have:

6 Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1 set Automatic Flush Bolts	3810 X 3810	606	TR
1 Storeroom Function Lockset	45H-7D16R PATD	606	BE
1 Coordinator	3094 x LENGTH REQUIRED	PC	TR
2 Closers	8916 IS PULL SIDE MOUNT STOP ARM	696	DM
2 Kick Plates	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
2 Dome Stops	1211	606	TR
1 Dust Proof Strike	3910	606	TR
1 Gasketing	5050 B @ HEAD AND JAMBS		NA
1 Meeting Astragal	5070 CL x HEIGHT AS REQUIRED		NA
1 Threshold	AS DETAILED		BY

SET #02 – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Classroom Function Lockset	45H-7R16R PATD	606	BE
1	Closer	8916 AF89 PULL SIDE MOUNT	696	DM
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Dome Stop	1211	606	TR
1	Gasketing	5050 B @ HEAD AND JAMBS		NA
1	Threshold	AS DETAILED		BY

SET #02A – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Storeroom Function Lockset	45H-7D16R PATD	606	BE
1	Closer	8916 IS PULL SIDE MOUNT		
		STOP ARM	696	DM
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Gasketing	5050 B @ HEAD AND JAMBS		NA
1	Threshold	AS DETAILED		BY

SET #02B – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Classroom Function Lockset	45H-7R16R PATD	606	BE
1	Closer	8916 SDS PUSH SIDE MOUNT STOP ARM	696	DM
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Gasketing	5050 B @ HEAD AND JAMBS		NA
1	Threshold	AS DETAILED		BY

SET #03 – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Office Function Lockset	45H-7A16R PATD	606	BE
1	Closer	8916 AF89 PULL SIDE MOUNT	696	DM
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Dome Stop	1211	606	TR
1	Gasketing	5050 B @ HEAD AND JAMBS		NA
1	Threshold	AS DETAILED		BY

SET #03A – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Office Function Lockset	45H-7A16R PATD	606	BE
1	Closer	8916 SDS PUSH SIDE MOUNT STOP ARM	696	DM
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Gasketing	5050 B @ HEAD AND JAMBS		NA
1	Threshold	AS DETAILED		BY

SET #04 – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Privacy Set	45H-0L16R VIB	606	BE
1	Closer	8916 AF89 PULL SIDE MOUNT	696	DM
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Mop Plate	KM050 4" x 1" LDW CSK B4E	606	TR
1	Wall Stop	1270WX	606	TR
1	Gasketing	5050 B @ HEAD AND JAMBS		NA
1	Threshold	AS DETAILED		BY

SET #05 – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Storeroom Function Lockset	45H-7D16R PATD	606	BE
1	Closer	8916 IS PULL SIDE MOUNT STOP ARM	689	DM
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Stop	1211 @ DOOR 316:1, REMAINDER - 1270WX	606	TR
1	Gasketing	5050 B @ HEAD AND JAMBS		NA
1	Threshold	AS DETAILED		BY

SET #05A – each opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Storeroom Function Lockset	45H-7D16R PATD	606	BE
1	Closer	8916 A89 PULL SIDE MOUNT	696	DM
1	Bracket	770SPB		ZE
1	Kick Plate	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Wall Stop	1270WX	606	TR
1	Sound Seal	770G @ HEAD AND JAMBS		ZE
1	Auto Door Bottom	369AA x DOOR WIDTH AS REQUIRED		ZE
1	Threshold	164G x DOOR WIDTH AS REQUIRED		ZE

SET #06 – each opening to have:

8	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
2	Cylinders	KEYED CYLINDERS AS REQUIRED		BE
2	Exit Devices	F9800 LB	606	DM
2	Exit Device Trims	ZG08	606	DM
2	Closers	8916 SDS PUSH SIDE MOUNT STOP ARM	696	DM
2	Brackets	770SPB		ZE
2	Kick Plates	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Length of Astragal	155G x 55G x DOOR HEIGHT AS REQUIRED		ZE
1	Sound Seal	770G @ HEAD AND JAMBS		ZE
2	Auto Door Bottoms	369AA x DOOR WIDTH AS REQUIRED		ZE
1	Threshold	164G x DOOR WIDTH AS REQUIRED		ZE

SET #06A – each opening to have:

8	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
2	Cylinders	KEYED CYLINDERS AS REQUIRED		BE
2	Exit Devices	F9800 LB	606	DM
2	Exit Device Trims	ZG08	606	DM
2	Closers	8916 SDS PUSH SIDE MOUNT STOP ARM	696	DM
2	Kick Plates	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
2	Brackets	770SPB		ZE
1	Length of Astragal	155G x 55G x DOOR HEIGHT AS REQUIRED		ZE
1	Sound Seal	770G @ HEAD AND JAMBS		ZE
2	Auto Door Bottoms	369AA x DOOR WIDTH AS REQUIRED		ZE
1	Threshold	164G x DOOR WIDTH AS REQUIRED		ZE

SET #07 – each opening to have:

8	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	set Automatic Flush Bolts	3810 X 3810	606	TR
1	Office Function Lockset	45H-7A16R PATD	606	BE
1	Coordinator	3094 x LENGTH REQUIRED	PC	TR
2	Closers	8916 IS PULL SIDE MOUNT STOP ARM	696	DM
2	Kick Plates	KO050 8" x 2" LDW B4E C-SUNK HOLES	606	TR
1	Dust Proof Strike	3910	606	TR
2	Brackets	770SPB		ZE
1	Length of Astragal	155G x 55G x DOOR HEIGHT AS REQUIRED		ZE
1	Sound Seal	770G @ HEAD AND JAMBS		ZE
2	Auto Door Bottoms	369AA x DOOR WIDTH AS REQUIRED		ZE
1	Threshold	164G x DOOR WIDTH AS REQUIRED		ZE

SET #08 – each opening to have:

1 Office Function Lockset	45H-7A16R PATD	606	BE
1 Hardware	CAM LIFT HINGES AND ACOUSTICAL SEALS		BY
	BY DOOR MANUFACTURER; MATCH FINISHES TO OTHER DOORS IN THE SAME ROOM		

SET #08A – each opening to have:

1 Office Function Lockset	45H-7A16R PATD	606	BE
1 Hardware	CAM LIFT HINGES AND ACOUSTICAL SEALS		BY
	BY DOOR MANUFACTURER; MATCH FINISHES TO OTHER DOORS IN THE SAME ROOM		

SET #AL 01 – each opening to have:

1 Continuous Hinge	662HD UL x HEIGHT REQUIRED	DB	ST
4 Cylinders	KEYED CYLINDERS AS REQUIRED		BE
1 Exit Device	9700 CD	613	DM
1 Door Pull	AP423 E P x HEIGHT AS REQUIRED x 10" AFF	613	TR
1 Closer	8916 SDS PUSH SIDE MOUNT STOP ARM	695	DM
1 Seals/Weatherstripping	PERIMETER SEALS BY DOOR MANUFACTURER		BY
1 Saddle/Threshold	THRESHOLD/SADDLE BY DOOR MANUFACTURER		BY

NOTE: Prep door and frame for future access control. Consult with Architect/Security.

SET #AL 02 – each opening to have:

1 Continuous Hinge	662HD UL x HEIGHT REQUIRED	DB	ST
1 set Door Pulls x BTB Mount	AP423 L P x HEIGHT AS REQUIRED x 10" AFF	613	TR
1 Closer	8916 SDS PUSH SIDE MOUNT STOP ARM	695	DM
1 Dome Stop	1211	613	TR
1 Seals/Weatherstripping	PERIMETER SEALS BY DOOR MANUFACTURER		BY
1 Saddle/Threshold	THRESHOLD/SADDLE BY DOOR MANUFACTURER		BY

SET #BO - BY OTHERS

See Specification Section 081713 FL - Integrated Metal Door Opening Assemblies for hardware.

SET #EX 01 – each existing opening to have:

3	Butt Hinges	FBB199 4.5" x 4.5"	4	ST
1	Classroom Function Lockset	45H-7R16M PATD	606	BE
1	Closer	8916 SDS PUSH SIDE MOUNT STOP ARM	695	DM
1	Threshold	AS DETAILED		BY

NOTE: Modify existing opening for new hardware, as detailed. Advise architect of any issues surrounding modifications.

SET #EX 02 - REUSE EXISTING HARDWARE**Manufacturer List**

<u>Code</u>	<u>Name</u>
BE	Best Access Systems
BY	By Others
DM	Dorma Door Controls
NA	National Guard
ST	BEST Hinges and Sliding
TR	Trimco
ZE	Zero

Finish List

<u>Code</u>	<u>Description</u>
4	Satin Brass, Clear Enameled
DB	Dark Bronze Anodized
PC	Prime Coat
606	Satin Brass, Clear Coated
696	Satin Brass Painted

END OF SECTION 087100

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL 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. Section Includes:
 - 1. Gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated on Drawings.
- B. STC Rating: As indicated on Drawings.
- C. Gypsum Shaftliner Board:
 - 1. Moisture- and Mold-Resistant Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch (25.4 mm) thick, and with double beveled long edges.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Certainteed; SAINT-GOBAIN.
 - 2) Georgia-Pacific Gypsum LLC.
 - 3) Gold Bond Building Products, LLC provided by National Gypsum Company.
 - 4) USG Corporation.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
 - 1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 (Z120) unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
 - 1. Depth: As indicated.
 - 2. Minimum Base-Metal Thickness: As indicated.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
- G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the 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. ClarkDietrich.
 - b. GCP Applied Technologies Inc.
 - c. SCAFCO Steel Stud Company.
- H. Finish Panels: As indicated.
- I. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."

2.3 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
 - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
- E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated).
- F. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

- D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

- B. Studs and Track: AISI S220.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. Marino\WARE.
 - c. SCAFCO Steel Stud Company.
2. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
3. Depth: As indicated on Drawings.

- C. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. Marino\WARE.
 - c. SCAFCO Steel Stud Company.
 - d. Minimum Base-Steel Thickness: 0.0190 inch (0.483 mm).
 - e. Depth: As indicated on Drawings.

- D. Slip-Type Head Joints: Where indicated, provide the following:

1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ClarkDietrich.
 - 2) Marino\WARE.
 - 3) SCAFCO Steel Stud Company.

- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width required for each fixture type.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. Marino\WARE.
 - c. SCAFCO Steel Stud Company.
 2. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
- F. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. Marino\WARE.
 - c. SCAFCO Steel Stud Company.
 2. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
 3. Depth: 7/8 inch (22.2 mm).

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, 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. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Adhesive anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: 1-1/2 inches (38 mm).
- E. Furring Channels (Furring Members):
1. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch (22 mm) deep.

- a. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. USG Corporation.
 - b. Armstrong Ceiling Solutions.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches (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.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
4. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - c. USG Corporation.
 - 2. Thickness: 5/8 inch (15.9 mm).
 - 3. Long Edges: Tapered.
- B. Gypsum Ceiling Board: ASTM C1396/C1396M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - c. USG Corporation.
 - 2. Thickness: 1/2 inch (12.7 mm).
 - 3. Long Edges: Tapered.
- C. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Gold Bond Building Products, LLC provided by National Gypsum Company.
2. Core: As indicated on Drawings.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:
 - a. Cornerbead.
 - b. L-Bead: L-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.7 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- C. Sound-Attenuation Blankets: ASTM C665, 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.
- D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 1. Wallboard Type: As indicated on Drawings.
 2. Type X: As indicated on Drawings.
 3. Ceiling Type: Ceiling surfaces.
 4. Impact-Resistant Type: Single-layer applications and exposed layer of multi-layer applications unless otherwise noted.
- B. Single-Layer Application:
 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from

parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. L-Bead: Use at exposed panel edges.

3.5 FINISHING OF GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

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SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Thresholds.
3. Tile backing panels.
4. Waterproof membranes.
5. Crack isolation membranes.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Module Size: Actual tile size plus joint width indicated.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- D. Samples for Verification:
1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
 2. Full-size units of each type of trim and accessory for each color and finish required.
 3. Stone thresholds in 6-inch (150-mm) lengths.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall meet one of the following requirements.

1. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
2. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile from single source or producer.
 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 2. Obtain waterproof membrane, except for sheet products, from manufacturer of setting and grouting materials.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 1. Provide tile complying with Standard grade requirements unless otherwise indicated.

- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

A. Factory-Mounted Mosaic Porcelain Tile Type 'Wall Tile':

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Olean; a brand of Dal-Tile Corporation.
 - b. Crossville, Inc. (Basis of Design)
 - c. Daltile; a brand of Dal-Tile Corporation.
2. Composition: Porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: 3 by 3 inch Mosaic Tile in 11-3/4 x 11-3/4-inch sheets with 1/8-inch grout joint.
5. Thickness: 1/4 inch (6.4 mm).
6. Face: Plain with cushion edges.
7. Surface: Smooth, without abrasive admixture.
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Basis of Design Product: Crossville Color Blox 2.0, 3 x 3 Mosaic.
10. Grout Color: As selected by Architect from manufacturer's full range.
11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: Cove, module size 6 -inch by 12-inch.
 - b. Internal Corners:
 - 1) Cove, module size 6 -inch by 12-inch.
 - 2) Field-butt square corners. For coved base and cap, use angle pieces designed to fit with stretcher shapes.

B. Porcelain Tile Type 'Floor Tile':

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Olean; a brand of Dal-Tile Corporation.
 - b. Crossville, Inc. (Basis of Design)
 - c. Daltile; a brand of Dal-Tile Corporation.
2. Certification: Tile certified by the Porcelain Tile Certification Agency.

3. Face Size: 11-13/16 by 11-13/16 inches (300 by 300 mm).
4. Thickness: 3/8 inch (9.5 mm).
5. Face: Plain with square or cushion edges.
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Basis of Design Product: Crossville Color Blox 2.0, 12 x 12 Field Tile.
8. Grout Color: As selected by Architect from manufacturer's full range.

2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.
- B. Granite Thresholds: ASTM C615/C615M, with honed finish.
 1. Description:
 - a. Uniform, medium-grained, brown stone without veining.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A, in maximum lengths available to minimize end-to-end butt joints.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Georgia-Pacific Gypsum LLC.
 - b. USG Corporation.
 2. Thickness: 5/8 inch (15.9 mm).

2.6 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Waterproof Membrane, Fluid-Applied: Liquid-latex rubber or elastomeric polymer.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik; Arkema.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
 - d. Sika Corporation.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils (0.1 mm) thick.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches (50.8 by 50.8 mm) by 0.062-inch (1.57-mm) diameter; comply with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.
3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik; Arkema.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.8 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bostik; Arkema.
 - b. Laticrete International, Inc.
 - c. MAPEI Corporation.
2. Polymer Type:
 - a. Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

- C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Laticrete International, Inc.
 - b. Summitville Tiles, Inc.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION OF CERAMIC TILE

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
 - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Tile:
 - a. Floor Tile: 3/16 inch.
 - b. Wall Tile (Mosaic Factory-Mounted Sheet): 1/8 inch.

- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
 - 2. Do not extend cleavage membrane or waterproof membrane under thresholds set in modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane or waterproof membrane with elastomeric sealant.
- J. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 INSTALLATION OF TILE BACKING PANELS

- A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 INSTALLATION OF WATERPROOF MEMBRANES

- A. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. TCNA F121 and ANSI A108.1C: Cement mortar bed (thickset) on waterproof membrane.
 - a. Ceramic Tile Type: Floor Tile.
 - b. Bond Coat for Cured-Bed Method: Modified dry-set mortar.
 - c. Grout: High-performance sanded grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. TCNA W244C or TCNA W244F: Thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Ceramic Tile Type: Wall Tile.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.

END OF SECTION 093013

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SECTION 095113 - 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.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.
 - 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

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

1.6 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.

1.7 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.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

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 E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E1264.
 - 2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Certainteed; SAINT-GOBAIN.
 - 2. Rockfon; ROCKWOOL International.
 - 3. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 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. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with acoustically transparent membrane and polyethylene foam.
 - 3. Pattern: E (lightly textured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.85.
- F. Ceiling Attenuation Class (CAC): Not less than 40.

- G. Noise Reduction Coefficient (NRC): Not less than 0.80.
- H. Articulation Class (AC): Not less than 170.
- I. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.
- J. Thickness: 1 inch (25 mm).
- K. Modular Size: 24 by 24 inches (610 by 610 mm).
- L. 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 D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Certainteed; SAINT-GOBAIN.
 - 2. Rockfon; ROCKWOOL International.
 - 3. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M 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 C635/C635M.
- C. Narrow-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 9/16-inch- (15-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-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.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Type: Postinstalled expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
 - 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, 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 A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 - 3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
 - 4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- (3.5-mm-) diameter wire.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Armstrong Ceiling & Wall Solutions.
 - 2. Certainteed; SAINT-GOBAIN.
 - 3. Fry Reglet Corporation.
 - 4. Gordon Inc.
 - 5. Rockfon; ROCKWOOL International.
 - 6. 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 lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 079219 "Acoustical 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 C636/C636M 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. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches (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.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of 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.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 4. 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.
 5. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

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SECTION 096248 – ISOLATED CONCRETE FLOORING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.2 WORK INCLUDED

- A. Work of the Section includes all labor, materials, equipment, and services necessary to complete the Isolated Concrete Floor System as shown on the drawings or indicated in the contract documents, including but not necessarily limited to the following:
 - 1. Resilient sound dampening underlayment for isolated concrete slab applications
 - 2. Resilient perimeter isolation matt.
 - 3. Waterproofing
 - 4. Reinforced concrete floor
- B. RELATED WORK
 - 1. Consult all other Sections to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner.
- C. SUBMITTALS
 - 1. Shop Drawings: Submit in accordance with Section 013300.
 - 2. Samples: Submit samples of underlayment in accordance with Section 013300.
- D. PRODUCT HANDLING
 - 1. Protection: Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed work and materials of all other trades.
 - 2. Replacements: In the event of damage, immediately make all repairs and replacements necessary.
 - 3. Store flooring materials in area of application. Allow a minimum of 3 days for material to reach equal temperature to area prior to pouring concrete.
- E. QUALITY ASSURANCE:
 - 1. Acoustical testing of isolated floor structure shall be conducted in an accredited independent acoustical laboratory. Sound transmission loss values shall be determined in accordance with ASTM E90-90. Sound Transmission Class (STC) shall be determined in accordance with ASTM E413-87. Impact Sound Transmission values shall be determined in accordance with ASTM E492-90. Impact Isolation Class (IIC) shall be determined in accordance with ASTM E989-89.
 - 2. The submission of shop drawings shall include all necessary calculations and manufacturer's certifications as required to demonstrate the suitability of the proposed installation. Calculations shall be performed by an approved licensed structural engineer with experience in the field of equipment support and seismic design, who shall be retained by the trade subcontractor for this purpose.

3. Isolated floor materials shall be designed and fabricated and the facilities of a nationally recognized manufacturer having a minimum of five years' experience in furnishing similar systems.
4. Manufacturer shall provide written certification that isolated floor system complies with local seismic restraint requirements.
5. Installation shall be performed by personnel instructed by the manufacturer or his representative on the proper technique and materials to be utilized.
6. Performance of isolated floor relies on the complete physical isolation of this construction from surrounding construction. Installer shall exercise extreme care in maintaining this isolation by preventing bridging of solid materials between isolated and adjacent construction.
7. No substitutions are to be made without approval. Any non-approved materials that have been installed shall be removed and replaced with approved materials at no expense to the Owner.

F. PERFORMANCE

1. Impact Insulation Class Laboratory (ASTM E492): Specified floor-ceiling assembly must be tested in a NVLAP certified laboratory and comply with ASTM standards. 25mm thickness shall be tested over a 6 in. concrete slab with 4 in. concrete topping to an IIC rating of 62 or greater.
2. Sound Transmission Class Laboratory (ASTM E90): Specified floor-ceiling assembly must be tested in a NVLAP certified laboratory and comply with ASTM standards. 25mm thickness shall be tested over a 6 in. concrete slab with 4 in. concrete topping to an STC rating of 69 or greater.
3. The maximum natural frequency of the isolation system shall be 14 Hz (+/- 2 Hz) over the entire load range of the floor system.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Floating Floor Underlayment

1. Re-bonded recycled rubber underlayment. Non-laminated, single ply, dimpled, with factory applied waterproof top surface.
 - a. Pliteq GenieMat FF-25
 - b. Sheet Dimension: rolled rubber underlayment will have an overall thickness of
 - 1) 1 in. [25 mm] standard in 4 ft. by 15 ft. [1.2 m by 4.6 m] roll size
 - c. Sheet Weight: 2.55 lb/ft² [12.45 kg/m²]
 - 1) Sheet Standard Tolerances: Roll width: + 3/4 in. - 0 in., Roll length: +1 percent - 0 in., Thickness: ± 0.3mm

B. Perimeter Isolation

1. Re-bonded Recycled Rubber Perimeter Isolation Strip
 - a. Pliteq Perimeter Rubber Isolation Strip (P.I.S.)
 - b. Pliteq GenieMat Polyethylene Foam Perimeter Isolation Strip

PART 3 - EXECUTION

3.1 GENERAL

- A. The installation of all sound isolation materials specified herein, including those installed under other sections of the specifications shall be in accordance with procedure submitted by the isolation material manufacturer and approved by the Architect, Structural Engineer, and Acoustical Consultant.

3.2 SEQUENCE OF CONSTRUCTION

- A. Installation of all mechanical and electrical equipment, ductwork, sprinkler piping, electrical conduit, and other services shall be coordinated with isolated floor construction. No penetrations of isolated floor shall be permitted.
 - 1. Clean substrate
 - 2. Prepare substrate in accordance with manufacturer's instructions.
 - 3. Prepare level plywood surface on suitable structure.
 - 4. Lay Base mat seam to seam covering the area as shown on the Contract Documents
 - 5. Install perimeter isolation board from the top of the underlayment to a minimum of 1 in. above the scheduled thickness of the isolated concrete slab.
 - 6. Ensure a maximum gap between the perimeter isolation board and underlayment of 1/8 in.
 - 7. Tape all joints between rolls of the base mat. Tape all joints between base mat and perimeter isolation board to avoid leakage during gypsum concrete pour.
 - 8. After floating gypsum slab has cured, cut back excess perimeter isolation board and caulk perimeter.

3.3 PENETRATIONS

- A. No slab penetrations shall be permitted.

3.4 INSPECTION

- A. Notification shall be given by the Contractor to the Architect at the following stage. Architect approval shall be obtained prior to proceeding to the next stage of construction.
 - 1. Upon completion of all areas prior to the placement of isolation material.
 - 2. Upon completion of placement of isolation materials prior to installation of isolated concrete slab.
 - 3. Upon completion of installation of concrete pouring form, prior to start of concrete pour.
 - 4. Upon completion of concrete isolated slab.

END OF SECTION 096248

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SECTION 096513 - 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. Section Includes:
 - 1. Thermoset-rubber base.
 - 2. Rubber molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended 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 resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 THERMOSET-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexco.
 - 2. Johnsonite; a Tarkett company.
 - 3. Roppe Corporation.
- B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style B, Cove: Provide in areas with resilient floor coverings and in areas indicated.
 - b. Cove Style: Long toe base.
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors: Match Architect's sample.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with anodized bronze finish, nominal 2 inches (50.8 mm) wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE 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. Vinyl composition floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
 - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended 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 floor tile during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.

- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Johnsonite, a Tarkett Company.
- B. Tile Standard: ASTM F1066, Class 2, through pattern.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch (3.2 mm).
- E. Size: 12 by 12 inches (305 by 305 mm).
- F. Colors and Patterns: Pattern as indicated by manufacturer's designations.. Color as selected by Architect from manufacturer's full range.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

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 floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. 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 F1869. 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 F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.

- B. Lay out floor 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.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply three coat(s).
- E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096623 - RESINOUS MATRIX TERRAZZO 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. Precast epoxy-resin terrazzo units.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:
 - 1. Locations for terrazzo wall base.
- C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.3 PRECAST EPOXY-RESIN TERRAZZO

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Precast Terrazzo Enterprises, Inc.
 2. Wausau Tile, Inc.
- B. Precast Terrazzo Base: Minimum 3/8-inch- (10-mm-) thick, epoxy terrazzo units cast in maximum lengths possible, but not less than 36 inches (900 mm). Comply with manufacturer's written instructions for fabricating precast terrazzo base units in sizes and profiles indicated.
 1. Type: Straight.
 2. Top Edge: Beveled with polished top surface.
 3. Outside Corner Units: With finished returned edges at outside corner.
 4. Color, Pattern, and Finish: As selected by Architect from full range of industry colors to match existing.

2.4 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.
- B. Anchoring Devices:
 1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

- C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and 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, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

3.3 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or improperly finished.
- C. Seal joints between units with joint compound matching precast terrazzo matrix.

3.4 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.5 CLEANING AND PROTECTION

- A. Cleaning:
 - 1. Remove grinding dust from installation and adjacent areas.
 - 2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096623

SECTION 096813 - 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:
 - 1. Modular carpet tile.
- B. Related Requirements:
 - 1. Section 024119 "Selective Demolition" for removing existing floor coverings.

1.3 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 edge, transition, and other accessory strips.
 - 9. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.

1.7 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at 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.

1.8 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 CARPET TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product:
 1. Product Indicated on Drawings: Statement Stone, Iconic Earth Collection, Mohawk Carpet, LLC; The Mohawk Group.
- B. Color: As selected by Architect from manufacturer's full range.
- C. Pattern: Mohawk Group Iconic Earth Collection, Statement Stone Tile, QB390.
- D. Fiber Type: Mohawk Group Colorstrand SD Nylon.
- E. Construction: Tufted
- F. Surface Texture: Textured Patterned Loop
- G. Pile Thickness: 0.068 inches for finished carpet tile.
- H. Stitches: 11.2 stitches per inch (mm).
- I. Gage: 1/12 per inch (mm).
- J. Tufted Pile Weight: 16.0 oz per sq. yd.
- K. Total Thickness: 0.242 inch.
- L. Dye Method: Solution dyed.
- M. Density: 8,576.
- N. Backing Material: Mohawk Group EcoFlex NXT.
- O. Size: 24 by 24 inches (610 by 610 mm).
- P. Applied Treatments:
 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
- Q. Performance Characteristics:
 1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D7330.
 2. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
 3. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
 4. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
 5. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.

6. Flammability: Meets or exceeds ASTM E 648 Class 1 (Glue Down).
7. Smoke Density: Less than 450 according to ASTM E 662.
8. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, 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.
- C. Metal Edge/Transition Strips: Extruded aluminum with anodized bronze 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. Existing Subfloor Substrates: Perform bond test recommended in writing by adhesive manufacturer.
 1. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 1/8 inch (3 mm), protrusions more than 1/32 inch (0.8 mm), and substances that may interfere with adhesive bond or show through surface.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 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. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," 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 recommended in writing by carpet tile manufacturer.
- 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 the Carpet and Rug Institute's CRI 104, Section 13.7.
- 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 096813

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SECTION 097200 - WALL COVERINGS

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. Textile wall covering.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate seams and termination points.
- C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches (914 mm) long in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
 - 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.
- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 265 or NFPA 286.
 3. Flammability: Passes NFPA-701 Large Scale; 1989.

2.2 TEXTILE WALL COVERING

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Guilford of Maine FR701.
- B. Description: Acoustically transparent, 100 percent post-consumer recycled polyester fabric.
- C. Pattern: Guilford of Maine 2100.
- D. Colors: As selected by Architect from manufacturer's full range.
- E. Contents: 100 percent Terratex Polyester.
- F. Weight: 16.0 +/- 0.5 oz. per linear yard.

- G. Width: 66 inch useable.
- H. Repeat: None.
- I. Backing: None.
- J. Performance:
 - 1. Tensile: 150 lbs minimum warp and fill according to ASTM D5034.
 - 2. Tear: 30 lbs minimum warp and fill according to ASTM D2261.
 - 3. Moisture Regain: 0.5 percent maximum according to ASTM D2654.
 - 4. Colorfastness to Light: Grade 4 minimum at 40 hours according to AATCC 16E.
 - 5. Colorfastness to Crocking: Class 4 minimum dry; Class 3 minimum wet according to AATCC 8.
 - 6. Flammability: Class 1 or A according to ASTM E84.

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
- B. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Painted Surfaces:
 - a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
 - b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
 - 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Install seams vertical and plumb at least 6 inches (152 mm) from outside corners and 6 inches (152 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
 - 1. Seam locations as indicated on drawings.
- F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 098433 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
 - 1. Sound-absorbing wall panels.
 - 2. Sound-diffusing wall panels.
- B. Related Requirements:
 - 1. Section 097200 "Wall Coverings" for textile wall coverings and for coordinated requirements for fabric.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include fabric facing, panel edge, core material, and mounting indicated.
- B. Shop Drawings: For unit assembly and installation.
 - 1. Include plans, elevations, sections, and mounting devices and details.
 - 2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
 - 3. Include details at cutouts and penetrations for other work.
 - 4. Include direction of fabric weave and pattern matching.
- C. Samples for Verification: For the following products:
 - 1. Fabric: Full-width by approximately 36-inch- (900-mm-) long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
 - 2. Panel Edge: 12-inch- (300-mm-) long Sample(s) showing each edge profile, corner, and finish.

3. Core Material: 12-inch- (300-mm-) square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Panels: Approximately 36 by 36 inches (900 by 900 mm), including joints and mounting methods.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Electrical outlets, switches, and thermostats.
 2. Items penetrating or covered by units.
 3. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
 1. Build mockup of typical wall areas 48 inches (1200 mm) wide by full height. Include intersection of wall and ceiling, corners, and perimeters.
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- B. Lighting: Do not install units until a lighting level of not less than 50 fc (538 lx) is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to the following:
 - a. Acoustical performance.
 - b. Fabric sagging, distorting, or releasing from panel edge.
 - c. Warping of core.
 - 2. Warranty Period: One year minimum from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.3 SOUND-ABSORBING WALL UNITS

- A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Basis-of-Design Product: Kinetics Noise Control, Inc., High Impact Hard Side Panels.
 - b. Acoustical Solutions.
 - c. Armstrong Ceiling & Wall Solutions.
 - d. Decoustics; CertainTeed Architectural Products; a Saint Gobain company.
 - e. Wenger Corporation.
2. Panel Shape: Flat.
3. Mounting: Edge mounted with splines secured to substrate.
 - a. Finish Color at Exposed Edges: Match color of facing material.
4. Mounting: Back mounted with manufacturer's standard hook-and-loop strips or metal clips or bar hangers, as recommended by manufacturer for each application, secured to substrate.
5. Core: Glass-fiber board..
 - a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board.
6. Edge Construction: Manufacturer's standard chemically hardened core with no frame.
 - a. Hardened with a Class A hardening solution.
7. Edge Profile: Square.
8. Reveals between Panels: Flush reveals.
9. Facing Material: 100 percent polyester fabric, FR701 Style 2100 by Guilford of Maine. Color
10. Acoustical Performance: Sound absorption NRC:
 - a. 1-1/8 inch panel thickness: 1.00, minimum.
 - b. 2-1/8 inch panel thickness: 1.05, minimum.
11. Nominal Core Thickness: 1 inch (25 mm) and 2 inches (51 mm). See drawings for locations.
12. Panel Width: As indicated on Drawings.
13. Panel Height: As indicated on Drawings.

2.4 SOUND-DIFFUSING WALL UNITS

- A. Sound-Diffusing Wall Panel: Vicoustic Multifuser Wood MKII, Multifuser Wood 64, manufactured by Vicoustic, www.vicoustic.com or comparable product.
 1. Color: Black.

2.5 MATERIALS

- A. Core Materials:
 1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft. (96 to 112 kg/cu. m), unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
 2. Tackable, Impact-Resistant, High-Density Board for Face Layer: 1/8-inch- (3.2-mm-) thick layer of compressed molded glass-fiber board with a nominal density of 10 pcf laminated to face of core.

3. Wood and Plywood: Plywood or clear, vertical grain, straight, kiln-dried hardwood.
 - a. Fire-retardant treated by pressure process with a flame-spread index of 25 or less when tested according to ASTM E84 or UL 723, 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) Treated material shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity.
 - 2) Kiln-dry material after treatment to 19 percent or less for lumber and 15 percent or less for plywood.
- B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.
 1. Manufacturer: Guilford of Maine.
 2. Product Line/Pattern: FR701.
 3. Pattern Repeat: None.
 4. Style Number: 2100.
 5. Fiber Content: 100 percent polyester fabric.
 6. Width: 66 inches (1676 mm).
- C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:
 1. Hook-and-Loop Strips: Manufacturer's standard.
 2. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.

2.6 ACCESSORY MATERIALS

- A. Sound-Absorbing Liner: Glass fiber board insulation, unfaced, minimum density 2.5 pcf, 2 inches thick.
 1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Owens Corning; QuietR Duct Liner Board.
 - b. Johns Manville; 800 Series Spin-Glas Fiberglass Duct and Equipment Rigid Board Insulation.
- B. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGM Industries, Inc.
 - b. Gemco.
2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

2.7 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Edge Hardening: For glass-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.
- C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
- D. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
 1. Square Corners: Tailor corners.
 2. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent units.
- E. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
 1. Thickness.
 2. Edge straightness.
 3. Overall length and width.
 4. Squareness from corner to corner.
 5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm) in 48 inches (1200 mm), noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch (1.6-mm) variation from reveal line in 48 inches (1200 mm), noncumulative.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 098433

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SECTION 098436 - SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
 - 1. Sound-reflecting ceiling panels.

1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For unit assembly and installation.
 - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
- B. Samples for Initial Selection: For each type of fabric facing.
 - 1. Include Samples of panel materials, hardware, and accessories involving color or finish selection.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
 - 1. Build mockup of typical sound reflective cloud panel..
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in protective wrapping and store in a temperature-controlled dry place with adequate air circulation.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify unit locations and actual dimensions of sound reflective cloud panels and indicate them on Shop Drawings.

PART 2 - PRODUCTS

2.1 SOUND-REFLECTING CEILING UNITS

- A. Sound-Reflecting Ceiling Panel: Shop-fabricated panel consisting of hardwood veneer plywood panel.
 - 1. Panel Shape: Square.
 - 2. Mounting: Back mounted with custom suspension system, secured to substrate.
 - 3. Panel Size: 48 inches (1220 mm) by 48 inches.

2.2 MATERIALS

- A. Provide Panels in accordance with "Paneling" in Section 062023 "Interior Finish Carpentry".
- B. Mounting Devices: Concealed on back or top edge of unit.
- C. Slotted Channel Framing Suspension System: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm) As indicated Insert size.
 - 2. Galvanized Steel: ASTM A653/A653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.
 - 3. Finish: Plain finish for field or shop painting.

2.3 FABRICATION

- A. Measure and establish layout of panels of as indicated on Drawings.
- B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:
 - 1. Thickness.
 - 2. Edge straightness.
 - 3. Overall length and width.
 - 4. Squareness from corner to corner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units.
- B. Mount units securely to supporting substrate.

3.3 CLEANING

- A. Clean panels on completion of installation to remove dust and other foreign materials.

END OF SECTION 098436

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SECTION 099113 - 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:

1. Primers.
2. Finish coatings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
4. Section 099300 "Staining and Transparent Finishing" for surface preparation and application of wood stains and transparent finishes on exterior wood substrates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. 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.

C. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin-Williams Company (The).
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.
- B. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

- A. Exterior, Alkali-Resistant, Water-Based Primer: Pigmented, water-based primer formulated for use on alkaline surfaces, such as exterior plaster, vertical concrete, and masonry.
- B. Epoxy Metal Primer: Corrosion-resistant, solvent-based, two-component epoxy primer formulated for use on prepared, exterior ferrous- and galvanized-metal surfaces.

2.4 FINISH COATINGS

- A. Exterior, Water-Based, Light Industrial Coating, Low Sheen: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
 - 1. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.
- B. Exterior, Water-Based, Light Industrial Coating, Gloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis,

moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.

1. Gloss Level: Manufacturer's standard gloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 4. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
 - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 - 3. Allow empty paint cans to dry before disposal.
 - 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Water-Based, Light Industrial Coating System:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, low sheen.

B. Steel and Iron Substrates:

1. Water-Based, Light Industrial Coating System:
 - a. Prime Coat: Epoxy metal primer or shop primer specified in Section in which substrate is specified.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, gloss.

C. Galvanized-Metal Substrates:

1. Water-Based, Light Industrial Coating System:
 - a. Prime Coat: Epoxy metal primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, gloss.

END OF SECTION 099113

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SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 055213 "Pipe and Tube Railings" for shop priming pipe and tube railings.
4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

- B. 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.

- C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of 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, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Sherwin-Williams Company (The).
- B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, 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. Colors: As selected by Architect from manufacturer's full range.

2.3 PRIMERS

- A. Alkali-Resistant, Water-Based Primer: Water-based primer formulated for use on alkaline surfaces, such as plaster, vertical concrete, and masonry.
- B. Interior Latex Primer for Wood: Waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbes; for hiding stains; and for use on interior wood subject to extractive bleeding.
- C. Interior Alkyd Primer Sealer: Solvent-based, alkyd-type, primer/sealer for new interior wood, plaster, and porous surfaces,
- D. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.
- E. Water-Based Galvanized-Metal Primer: Corrosion-resistant, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.

2.4 WATER-BASED FINISH COATS

- A. Interior, Water-Based Light-Industrial Coating, Eggshell: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
 - 1. Gloss and Sheen Level: Manufacturer's standard eggshell finish.
- B. Interior, Water-Based Light-Industrial Coating, Semigloss: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
 - 1. Gloss Level: Manufacturer's standard semigloss finish.
- C. Interior, Latex, High-Performance Architectural Coating, Low Sheen: High-performance architectural latex coating providing a significantly higher level of performance than conventional latex paints in the areas of scrub resistance, burnish resistance, and ease of stain removal.
 - 1. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.
- D. Interior, Latex, High-Performance Architectural Coating, Eggshell: High-performance architectural latex coating providing a significantly higher level of performance than conventional latex paints in the areas of scrub resistance, burnish resistance, and ease of stain removal.
 - 1. Gloss and Sheen Level: Manufacturer's standard eggshell finish.
- E. Interior, Latex, High-Performance Architectural Coating, Semigloss: High-performance architectural latex coating providing a significantly higher level of performance than conventional latex paints in the areas of scrub resistance, burnish resistance, and ease of stain removal.
 - 1. Gloss Level: Manufacturer's standard semigloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Wood: 15 percent.
 - 3. Gypsum Board: 12 percent.
 - 4. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.

- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- G. 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.
- H. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in occupied spaces:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Metal conduit.
 - e. Plastic conduit.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Other items as directed by Architect.
 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

- 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Alkali-resistant, water based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior latex, high-performance architectural coating, low sheen.

B. Steel Substrates:

- 1. Water-Based Light-Industrial Coating System:
 - a. Prime Coat: Primer, rust-inhibitive, water based.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, eggshell and semigloss.

C. Galvanized-Metal Substrates:

- 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Water-based galvanized primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, semigloss.

D. Finish Carpentry: Wood trim.

- 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, semigloss.

E. Gypsum Board and Plaster Substrates:

- 1. High-Performance Architectural Latex System:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, low sheen and eggshell.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers
2. Wood stains.
3. Transparent finishes.

B. Related Requirements:

1. Section 099123 "Interior Painting" for stains and transparent finishes on concrete floors.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 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 finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MOCKUPS

A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals and.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.
- C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & Co.
 2. PPG Paints; PPG Industries, Inc.
 3. Pratt & Lambert; a subsidiary of The Sherwin-Williams Company.
 4. Sherwin-Williams Company (The).

2.2 SOURCE LIMITATIONS

- A. Source Limitations: Obtain each coating product from single source from single manufacturer.

2.3 MATERIALS, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

- B. Stain Colors: Match Architect's samples.

2.4 WOOD STAINS

- A. Stain, Interior, Semitransparent, for Interior Wood: Solvent-based, oil or oil/alkyd, semitransparent, pigmented stain for new interior wood surfaces that are to be finished with a clear varnish.

2.5 TRANSSPARENT FINISHES

- A. Varnish, Interior Polyurethane, Moisture Cured, Gloss: Solvent-based, moisture-curing polyurethane clear-coating with a gloss finish for interior wood surfaces,
 - 1. Gloss Level: Manufacturer's standard gloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

C. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Wood Trim, Architectural Woodwork, Doors, Windows, and, Wood Board Paneling:

1. Moisture-Cured Clear Polyurethane over Stain System:

- a. Stain Coat: Stain, semitransparent, for interior wood.
- b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.
- c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
- d. Topcoat: Varnish, polyurethane, moisture cured, gloss.

B. Wood Substrates, Traffic Surfaces, Including Floors:

1. Moisture-Cured Clear Polyurethane over Stain System:

- a. Stain Coat: Stain, semitransparent, for interior wood.
- b. First Intermediate Coat: Moisture-cured polyurethane matching topcoat.

- c. Second Intermediate Coat: Moisture-cured polyurethane matching topcoat.
- d. Topcoat: Varnish, polyurethane, moisture cured, gloss.

END OF SECTION 099300

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SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification and panel signs that are directly attached to the building.

1.2 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Panel and Room-Identification Sign: with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Mohawk Signs Systems
- C. Basis of Design Product: Series 200A – Sand Carved by Mohawk Signs Systems.
 - 1. Laminated-Sheet Sign: Sandblasted polymer face sheet with laminated to contrasting phenolic core to produce composite sheet.
 - a. Composite-Sheet Thickness: 0.125 inch (3.18 mm).
 - b. Sandblasted Graphics: Laminate sandblasted to remove background material to create raised graphics and expose contrasting phenolic core.
 - c. Color(s): As selected by Architect from manufacturer's full range.
 - 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition at Vertical Edges at Horizontal Edges: Square cut.
 - b. Corner Condition in Elevation: Square.
 - 3. Frame (Exterior Signs): Entire perimeter.
 - a. Material: Aluminum.
 - b. Material Thickness: 1/16".
 - c. Frame Depth: 1/2".
 - d. Profile: Square.
 - e. Corner Condition in Elevation: Square.
 - f. Finish and Color: Dark bronze anodized .
 - 4. Mounting: Surface mounted to wall with concealed anchors for exterior signs and two-face tape for interior signs.
 - 5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.5 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
 - 1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 102213 - WIRE MESH PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Standard-duty wire mesh partitions.

1.2 DEFINITIONS

- A. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Wire mesh partitions.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Indicate clearances required for operation of doors.
- C. Samples for Selection: Manufacturer's standard color sheets, showing full range of available colors for units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wire mesh partition hardware.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wire mesh items palletted, and wrapped to provide protection during transit and Project-site storage. Use vented plastic.
- B. Store wire mesh in a dry area out of weather and prohibit stacking other materials on top.
- C. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.
- D. Deliver keys to Owner

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Basis-of-Design Product: Subject to compliance with requirements, provide ACORN Wire & Iron Works; 130A, Standard Duty or comparable product by one of the following:
 - a. Folding Guard Corporation.
 - b. Indiana Wire Products, Inc.

2.2 SOURCE LIMITATIONS

- A. For wire mesh products, obtain each color, grade, finish, type, and variety from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Wire mesh units to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 1. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m) at any location on a panel.
 2. Total load of 200 lbf (0.89 kN) applied uniformly over each panel.
 3. Concentrated load and total load need not be assumed to act concurrently.
- B. Seismic Performance: Wire mesh units to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

2.4 STANDARD-DUTY WIRE MESH PARTITIONS

- A. Mesh: 0.135-inch- (3.5-mm-) diameter, intermediate-crimp steel wire woven into 1-1/2-inch (38-mm) diamond mesh.
- B. Vertical Panel Framing: 1-1/4-by-5/8-by-0.080-inch (32-by-16-by-2.0-mm) cold-rolled, C-shaped steel channels with holes for 1/4-inch- (6-mm-) diameter bolts not more than 12 inches (300 mm) o.c.
- C. Horizontal Panel Framing: 1-by-1/2-by-1/8-inch (25-by-13-by-3.2-mm) cold-rolled steel channels.
- D. Horizontal Panel Stiffeners: Two cold-rolled steel channels, 3/4 by 3/8 by 1/8 inch (19 by 9.5 by 3.2 mm), bolted or riveted toe to toe through mesh; or one 1-by-1/2-by-1/8-inch (25-by-13-by-3.2-mm) cold-rolled steel channel with wire mesh woven through channel.
- E. Top Capping Bars: 2-1/4-by-1-inch (57-by-25-mm) cold-rolled steel channels.
- F. Posts for 90-Degree Corners: 1-1/4-by-1-1/4-by-1/8-inch (32-by-32-by-3.2-mm) steel angles or square tubes with holes for 1/4-inch- (6-mm-) diameter bolts aligning with bolt holes in vertical framing; with floor anchor clips.
- G. Floor Shoes: Metal, not less than 2 inches (50 mm) high; sized to suit vertical framing, drilled for attachment to floor, and with setscrews for leveling adjustment.

- H. Swinging Doors: Fabricated from same mesh as partitions, with framing fabricated from 1-1/4-by-1/2-by-1/8-inch (32-by-13-by-3.2-mm) steel channels or 1-1/4-by-5/8-by-0.080-inch (32-by-16-by-2.0-mm) cold-rolled, U-shaped steel channels, banded with 1-1/4-by-1/8-inch (32-by-3.2-mm) flat steel bar cover plates on three sides, and with 1-1/2 by 7/8-by 0.105 inch, 12 gauge thick angle strike bar and cover on strike jamb.
 - 1. Hinges: Full-surface type, 3-by-3-inch (76-by-76-mm) steel, three per door; bolted, riveted, or welded to door and jamb framing.
 - 2. Cylinder Lock: Mortise type with manufacturer's standard cylinder; operated by key outside and recessed turn knob inside.
- I. Accessories:
 - 1. Wall Clips: Manufacturer's standard, steel sheet.
- J. Finish: Hot-dip galvanized unless otherwise indicated.

2.5 MATERIALS

- A. Steel Wire: ASTM A510/A510M.
- B. Steel Plates, Channels, Angles, and Bars: ASTM A36/A36M.
- C. Steel Sheet: Cold-rolled steel sheet, ASTM A1008/A1008M, Commercial Steel (CS), Type B.
- D. Steel Tubing: ASTM A500/A500M, cold-formed structural-steel tubing or ASTM A513/A513M, Type 5, mandrel-drawn mechanical tubing.
- E. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.
- F. Post-Installed 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 in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components are zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
- G. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.6 FABRICATION

- A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. Furnish bolts, hardware, and accessories required for complete installation with manufacturer's standard finishes.
- B. Standard-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.
 - 1. Mesh: Securely clinch mesh to framing.

2. Fabricate wire mesh partitions with 3 to 4 inches (75 to 100 mm) of clear space between finished floor and bottom horizontal framing.
3. Doors: Align bottom of door with bottom of adjacent panels.
 - a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.
4. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

2.7 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

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. Examine floors for suitable conditions where wire mesh items will be installed.
- C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRE MESH PARTITIONS

- A. Install wire mesh partition in accordance with manufacturer's shop drawings.
- B. Install doors complete with door hardware.

3.3 REPAIR

- A. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

3.4 ADJUSTING

- A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Verify that latches and locks engage accurately and securely without forcing or binding.

3.5 PROTECTION

- A. Remove and replace defective work, including doors and framing that are warped, bowed, or otherwise unacceptable.

END OF SECTION 102213

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Underlavatory guards.
 - 3. Custodial accessories.

1.2 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Include electrical characteristics.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

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

1.6 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
 - 1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser [Accessory C]:
 - 1. Basis of Design: As indicated on Drawings.
 - 2. Description: Double-roll dispenser.
 - 3. Mounting: Surface mounted.
 - 4. Operation: Noncontrol delivery with theft-resistant spindle.
 - 5. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
 - 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- C. Combination Towel (Folded) Dispenser/Waste Receptacle [Accessory E]:
 - 1. Basis of Design: As indicated on Drawings.
 - 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 - 3. Mounting: Recessed with projecting receptacle.
 - a. Designed for nominal 4-inch (100-mm) wall depth.
 - 4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
 - 5. Minimum Waste-Receptacle Capacity: 12 gal. (45.4 L).
 - 6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - 7. Liner: Reusable, vinyl waste-receptacle liner.
 - 8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.
- D. Automatic Soap Dispenser [Accessory D]:

1. Basis of Design: As indicated on Drawings.
2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in liquid or lotion form.
3. Mounting: Surface mounted.
4. Capacity: 30 fl oz (850 ml)
5. Materials: Stainless steel, ASTM A480/A480M No. 4 finish (satin)
6. Refill Indicator: clear acrylic window.
7. Low-Battery Indicator: LED indicator.
8. Lock: Key lock

E. Grab Bar [Accessory A]:

1. Basis of Design: As indicated on Drawings.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin on ends and slip-resistant texture in grip area).
4. Outside Diameter: 1-1/4 inches (32 mm).
5. Configuration and Length: As indicated on Drawings.

F. Sanitary-Napkin Disposal Unit [Accessory F]:

1. Basis of Design: As indicated on Drawings.
2. Mounting: Recessed.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

G. Mirror Unit Toilet [Accessory B]:

1. Frame: Stainless steel angle, 0.05 inch (1.3 mm) thick.
 - a. Corners: Welded and ground smooth.
2. Size: As indicated on Drawings.
3. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

2.3 UNDERLAVATORY GUARDS

A. Underlavatory Guard [Accessory I]:

1. Basis of Design: As indicated on Drawings.
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. Custodial Mop and Broom Holder [Accessory H]:

1. Basis of Design: As indicated in the Drawings
2. Description: Unit with shelf, hooks, and holders.
3. Length: 36 inches (914 mm).
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.

2.5 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- (0.9-mm) minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- F. Mirrors: ASTM C1503, 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 in accordance with 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.
 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

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SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

- a. Portable fire extinguisher.
- b. Fire-hose valve.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- 2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers and hose valves indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 FIRE-PROTECTION CABINET FEC-1 (RECESSED) AND FEC-2 (SURFACE)

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. Guardian Fire Equipment, Inc.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - d. Nystrom, Inc.
 - e. Potter Roemer LLC; a Division of Morris Group International.
- B. Cabinet Construction: Nonrated (FEC-2) and One-hour fire rated (FEC-1).
 - 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. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- F. Cabinet Trim Material: Steel sheet.
- G. Door Material: Steel sheet.
- H. Door Style: Fully glazed panel with frame.

- I. Door Glazing: Acrylic sheet.
 - 1. Acrylic Sheet Color:
 - a. Clear transparent acrylic sheet.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide projecting door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- K. Accessories:
 - 1. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
- L. Materials:
 - 1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Architect from manufacturer's full range.
 - 2. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.4 FIRE-PROTECTION CABINET HVC-1 (RECESSED) AND HVC-2 (SURFACE)

- A. Cabinet Type: Suitable for hose valve.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. Guardian Fire Equipment, Inc.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - d. Nystrom, Inc.
 - e. Potter Roemer LLC; a Division of Morris Group International.
- B. Cabinet Construction: Nonrated (HVC-2) and One-hour fire rated (HVC-1).
 - 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. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Fully glazed panel with frame.

I. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color:
 - a. Clear transparent acrylic sheet.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.

L. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
 - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - c. Color: As selected by Architect from manufacturer's full range.

2.5 Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

2.6 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 and grind smooth.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:
 - 1. Fire-Protection Cabinet Mounting Height: 42 inches (1067 mm) above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Fire-Rated Hose-Valve Cabinets:
 - a. Install cabinet with not more than 1/16-inch (1.6-mm) tolerance between pipe OD and knockout OD. Center pipe within knockout.
 - b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

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. Babcock-Davis.
 - b. Guardian Fire Equipment, Inc.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - d. Kidde; Carrier Global Corporation.
 - e. Larsen's Manufacturing Company.
 - f. Nystrom, Inc.
 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 3. Valves: Manufacturer's standard.
 4. Handles and Levers: Manufacturer's standard.
 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red or black baked-enamel finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis.
 - b. Guardian Fire Equipment, Inc.
 - c. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
 - d. Kidde; Carrier Global Corporation.
 - e. Larsen's Manufacturing Company.
 - f. Nystrom, Inc.
 - g. Potter Roemer LLC; a Division of Morris Group International.
 2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
 - 1. Mounting Height: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

END OF SECTION 104416

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SECTION 111316 - LOADING DOCK SEALS AND SHELTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Transparent-strip door curtains.

1.2 COORDINATION

- A. Coordinate sizes, configurations, and mounting of transparent-strip door curtains with walls, doors, dock levelers, and other adjacent construction.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of dock openings and contiguous construction by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 TRANSPARENT-STRIP DOOR CURTAINS

- A. General: Door curtains consisting of overlapping strips suspended from top of opening to form a sealed door curtain. Provide strips of length required to suit opening height and with sufficient unit number to close opening width with overlap indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Singer Safety Company; Vinyl Strip Doors or a comparable product approved by the Architect:
 - 2. Source Limitations: Obtain from single source from single manufacturer.

- B. Strip Material: Curved, clear, transparent, extruded PVC. Fabricate strips for manufacturer's standard method of attachment to overhead mounting system indicated.
 - 1. Standard Grade: Designed to withstand temperature range of 0 to plus 150 deg F (minus 18 to plus 66 deg C).
 - 2. Strip Dimensions: 8 inches (203 mm) and 0.080 inch (2 mm) width and thickness, respectively.
 - 3. Overlap: One-half.
- C. Mounting System:
 - 1. Offset Mounting: Consisting of an aluminum extrusion or angle projecting out on each side of door opening to allow hanging strips to clear overhead door hood. Equip with permanently attached mounting pins and a steel angle or plate retaining strip attached to angle with wing nuts. Return hanging strips to face of wall at jambs to fully enclose space interior to overhead door.
 - a. Manufacturer's standard mounting system permanently attached to ceiling structure or wall as required for intended configuration. Provide universal mounting kit, including snap cap fasteners. Lengths as required for three-sided curtain.
- D. Steel Finish: Hot-dip galvanize components to comply with the following:
 - 1. ASTM A123/A123M for iron and steel support mounting.
 - 2. ASTM A153/A153M or ASTM F2329 for iron and steel hardware and anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION OF TRANSPARENT-STRIP DOOR CURTAINS

- A. Attach door-curtain mounting system per manufacturer's instructions and approved shop drawings. Mount curtain strips to overlap.

3.3 ADJUSTING

- A. After completing installation, inspect exposed factory finishes and repair damaged finishes.

END OF SECTION 111316

SECTION 111319 - STATIONARY LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Stationary loading dock lifts (scissor lifts).
 - 2. Dock bumper bollards.
- B. Related Requirements:
 - 1. Section 111316 "Loading Dock Seals and Shelters" for loading dock seals and shelters.

1.3 DEFINITIONS

- A. Operating Range: Maximum amount of travel above and below the loading dock level.
- B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.4 COORDINATION

- A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation
- B. Coordinate installation of cast-in-place items. Furnish setting drawings and templates.
- C. Electrical System Roughing-in: Coordinate layout and installation of loading dock equipment with connections to power supplies and interlocked equipment.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
 - 2. Review sequence of operation for each type of loading dock equipment.
 - 3. Review coordination of interlocked equipment specified in this Section and elsewhere.
 - 4. Review required testing, inspecting, and certifying procedures.

1.6 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 stationary loading dock equipment.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For stationary loading dock equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and each field connection.
3. Include diagrams for power, signal, and control wiring.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Sample Warranty: For manufacturer's special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer providing sole source for design, engineering, manufacturing, and warranty claims handling. Company specializing in manufacturing products specified with a minimum of 20 years experience.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1. Maintenance Proximity: Not more than one hours' normal travel time from Installer's place of business to Project site.

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/D1.3M, "Structural Welding Code - Sheet Steel."

1.10 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including slopes of driveways and heights of loading docks, by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 STATIONARY LOADING DOCK LIFTS

- A. General: Stationary, scissors-type, hydraulic dock lift of capacity, size, and construction indicated; complete with controls, safety devices, and accessories required.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Pentalift Hydraulic Lift Table Model 7P486 Pro Series or comparable product by one of the following:
 - a. Advance Lifts, Inc.
 - b. Autoquip Corporation.
 - c. Blue Giant Equipment Corporation.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Standard: MH 29.1.
- D. Rated Capacity: Lifting capacity of not less than 6,000 lbs.
- E. Platform: Nonskid, safety-tread heavy hot-dip galvanized- steel deck plate.
 - 1. Platform Size: 48 inches wide by 88 inches long.
 - 2. Platform Guarding: Bevel toe guards to comply with requirements in MH 29.1.
 - 3. Removable Guard Rails: Provide hot-dip galvanized-steel guard rails on two sides of platform with a single, removable chain across each end. Provide guard rails not less than 39 inches (991 mm) high with midrail and 4-inch- (102-mm-) high, kick plate at bottom. Mount rail sockets flush with platform surface.
- F. Bridge: Nonskid, safety-tread, hot-dip galvanized-steel plate.
 - 1. Hinged Bridge: Hinged, throw-over bridge bolted to full-length, heavy-duty, piano-type hinge welded to toe guard at end of platform. Provide bridge complete with heavy-duty lifting chains. Chamfer edge of bridge to minimize obstructing wheels of material-handling vehicles.
 - 2. Size: 24 inches long by 88 inches wide.
 - 3. Locations: Ends.
- G. Function: Dock lifts shall compensate for differences in height between truck bed and loading platform.
 - 1. Vertical Travel: Maximum of 48 inches (mm) from a lowered height of 8 inches (mm) for a total raised height of 56 inches (mm).
 - 2. Hinged Throw-over Bridge Operation: Manual with lifting chains.

- H. Hydraulic Operating System: Self-contained, electric, hydraulic power unit for raising and lowering lift; of size, type, and operation needed for capacity of lift indicated; controlled from a remotely located push-button station.
1. Power Unit: Consisting of continuous-duty motor, high-pressure gear pump, valve manifold, oil-line filters, and oil reservoir.
 - a. Equip manifold with relief valve, check valve, pressure-compensated flow-control valve, and solenoid valve and with provisions for lowering lift manually if power fails.
 - b. Equip reservoir, valve manifold, and pressure line with oil-line filters.
 2. Cylinders: Equip lift with not less than two heavy-duty, high-pressure, hydraulic, ram-type cylinders. Rams shall be manufacturer's standard, either direct-displacement-plunger or rod-and-piston type with positive internal stops. Cylinder rods shall be chrome plated and polished.
 - a. Rate of Descent Protection: Pressure-compensated flow control or hydraulic velocity fuse to limit down speed for each cylinder.
 3. Remote-Control Station: Multibutton control station of the constant-pressure type with UP and DOWN push buttons. Controller shall consist of magnetic motor starter with three-pole adjustable overloads and 24-V control transformer with 4-A, fused secondary prewired to terminal strips and enclosed in NEMA ICS 6, Type 12 box.
 - a. Upper-Travel-Limit Switch: Equip unit with manufacturer's standard, adjustable, upper-travel-limit switch.
- I. Construction: Fabricate lift from structural-steel shapes rigidly welded and reinforced for maximum strength, safety, and stability. Design assembly to withstand deformation during both operating and stored phases of service. Provide mounting brackets and removable lifting eyes for ease of installation.
1. Scissors Mechanism: Fabricate leg members from heavy, hot-dip galvanized- steel-formed tube or plate members to provide maximum strength and rigidity.
 2. Bearings: Pivot points with permanently lubricated antifriction bushings or sealed ball-bearings for minimum maintenance.
 3. Maintenance Leg: Removable, safety maintenance leg or hinged, safety maintenance bars.
 4. Mounting: Surface.
- J. Materials:
1. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
 2. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from steel plate complying with ASTM A572/A572M, Grade 55 (380).
 3. Steel Tubing: ASTM A500/A500M, cold formed.
- K. Dock Lift Finish: Manufacturer's standard epoxy finish unless otherwise indicated.

2.2 DOCK ACCESSORIES

A. Dock Bumper Bollards

1. Cast-in-Place Steel Bollard: Steel construction (ASTM A36 MIN) with welding to meet AWS. Lagging anchors at base for cast-in-place installation.

- a. Height: 62 inches usable height; 72 inches overall height.
- b. Outside Diameter: 4-1/2 inches.
- c. Finish: Baked on powder coat in yellow finish with black and yellow safety stripes.
- d. Removable top cap.
- e. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1) Vestil Manufacturing, Pour in Place Bollard, BOLPP-62-4.5.

2.3 FINISH REQUIREMENTS

- A. Finish loading dock equipment after assembly and testing.
- B. Hot-Dip Galvanizing: Comply with the following:
 - 1. ASTM A123/A123M for iron and steel loading dock equipment.
 - 2. ASTM A153/A153M or ASTM F2329/F2329M for iron and steel hardware for loading dock equipment.
- C. Spray Zinc Metallizing: ASTM B833.
- D. Electrodeposited Zinc Coatings: ASTM B633.
- E. Steel Prime Paint Finish: Clean, pretreat, and apply manufacturer's standard primer.
- F. Epoxy Factory Finish: Clean, pretreat, and apply manufacturer's standard epoxy finish.
 - 1. Color: Match Architect's sample.
 - 2. Toe Guards: Paint to comply with ANSI Z535.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install loading dock equipment as required for a complete installation.
 - 1. Rough-in electrical connections.

3.3 INSTALLATION OF STATIONARY LOADING DOCK LIFTS

- A. Attach dock lifts securely to loading platform.

3.4 ADJUSTING

- A. Adjust loading dock equipment to function smoothly and safely and lubricate as recommended by manufacturer.
- B. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.5 MAINTENANCE SERVICE

- A. Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of loading dock equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION 111319

SECTION 116123 - FOLDING AND PORTABLE STAGES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seating-platform risers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of unit and their various assembly configurations.
2. Include load capacities, assembly characteristics, and furnished accessories.

B. Shop Drawings: For folding and portable risers.

1. Include plans, elevations, sections, and details.
2. Include load capacities.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For folding and portable stages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Folding and portable stages and components shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Risers:
 - a. Uniform Load: 125 lbf/ft² (6 kN/m²) to 200 lbf/ft² (9.6 kN/m²).
 - b. Dynamic Live Load: Side load of 15% of total Uniform Live Load which equals 600 lbf (2.7 kN) side load on a platform under a total Uniform Live Load of 4,000 lbf (17.8 kN).
 - c. Point Load: 1,500lbf (6.7 kN) applied via 1" (25 mm) diameter pin.
2. Guards and Handrails: Meet or exceed building code requirements.

2.2 SEATING-PLATFORM RISERS

- A. Folding and Portable Seating-Platform Risers: Modular, seating-platform risers fabricated with three risers with chair surface not less than 36 inches (914 mm) deep, riser heights in 8-inch (203-mm) increments.
 - 1. Match existing platform risers to provide configuration indicated.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Wenger Corporation.
- B. Frame: Platform frame, legs, and braces shall be cold-rolled galvanized steel, cold-formed steel tubing, steel mechanical tubing, or extruded-aluminum shapes. Supporting members shall fold within platform frame for minimum storage volume, with fail-safe catches and bracing members to securely lock supports in open position. Provide nonmarking plastic or rubber leg tips to protect permanent flooring, and coupler devices designed to lock platform units together securely and in correct position.
- C. Platform Deck: Manufacturer's standard platform panel construction, with steel or aluminum trim at perimeter of each panel, and the following:
 - 1. Finish: Match existing vinyl flooring.
 - 2. Color: Match existing.

2.3 ACCESSORIES

- A. Railings: Platform or riser manufacturer's metal railing system consisting of 1-1/4- or 1-1/2-inch (32- or 38-mm) OD tubing and necessary fittings to attach to platforms or risers.
- B. Guardrails: Platform or riser manufacturer's guardrail system consisting of 1-1/4- or 1-1/2-inch (32- or 38-mm) OD tubing and necessary fittings to attach to platforms or risers not less than 42 inches (1067 mm) high.
 - 1. Infill Balusters: Spaced less than 4 inches (102 mm) apart.
- C. Chair Stops and Toe Boards: Chair stops or toe board, or both, at platform around openings and at edges where railings and open-sided platforms are located.
 - 1. Toe-Board Height: Not less than 4 inches (102 mm).
- D. Storage Trucks: Manufacturer's standard wheeled storage platforms designed to store entire quantity of stage units and accessories required for Project. Fabricate trucks of welded steel with four heavy-duty wheels or casters, including not less than two swivel casters. Fabricate wheels and casters from materials that will not damage or mark floors.

2.4 MATERIALS

- A. Plywood: PS 1.
- B. Medium-Density Fiberboard: ANSI A208.2.
- C. Hardboard: ANSI A135.4, Tempered Class.

- D. Honeycomb-Core Board: Manufacturer's standard laminated composite.
- E. Hardware and Fasteners: Manufacturer's standard noncorroding type.

2.5 FABRICATION

- A. Fabricate folding and portable stages to be portable and capable of being assembled and disassembled without special tools or separate fasteners.
- B. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.
- C. Form exposed work with flat, flush surfaces, level and true in line.
- D. Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of folding and portable stages without failure or other conditions that might impair their usefulness.

PART 3 - EXECUTION

3.1 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain folding and portable stages.
- B. Assemble folding and portable stages in locations indicated to verify that components are complete and in proper working order. Begin assembly demonstration using units in their as-stored condition.
- C. Adjust hardware, moving parts, and safety devices to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 116123

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SECTION 122200 - CURTAINS AND DRAPES

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. Drapes.
 - 2. Drapery tracks.

1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Drapery Tracks: Include maximum weights of drapes that can be supported.
 - 2. Fabrics.
 - 3. Textile treatments.
- B. Shop Drawings:
 - 1. Drapery Tracks: Show installation and anchorage details and locations of controls.
 - 2. Drapes: Show sizes, locations, and details of installation.
- C. Samples: As follows:
 - 1. Drapery Fabrics: For each color and pattern indicated, full width by 36 inches (1000 mm) long, from dye lot to be used for the Work and with specified textile treatments applied. Show complete pattern repeat if any. Mark top and face of fabric.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each drapery fabric treated with flame retardant, signed by fabric supplier and indicating treatment durability and cleaning procedures required to maintain treatment effectiveness.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: For drapes and drapery tracks, fabricator of drapes.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before drape fabrication, and indicate measurements on Shop Drawings.
- B. Scheduling: Do not deliver or install drapes until after other finish work, including painting, is complete and spaces are otherwise ready for occupancy.

PART 2 - PRODUCTS

2.1 DRAPERY TRACKS

- A. Manually Operated Track:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Automatic Devices Company, 280/281 Silent Steel Track Systems, or comparable products if available.
 2. Construction: Galvanized steel, 14 gauge, slotted for mounting at interval of not more than 24 inches (610 mm) o.c.
 - a. Lengths and Configurations: As indicated on Drawings.
 - b. Support Capability: Weight of drape indicated mounted on track length indicated.
 3. Mounting Brackets: Of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drape plus force applied to operate track.
 - a. Mounting Surface: As indicated on Drawings.
 4. Installation Fasteners: Sized to support track assembly and drape, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
 5. Operation: Baton.
 - a. Draw: One-way stack and two way, center opening as indicated on Drawings.
 - b. Operating Hardware Location: As indicated on Drawings.
 6. Carriers: Rollers with hooks.
 - a. Master Carriers: Butt.
 7. End Stops: Manufacturer's standard.
 8. Accessories: Extension wand or cord for baton operation.

2.2 DRAPES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Georgia Stage, LLC, www.gastage.com.
 2. North East Stage, LLC, www.northeaststage.com.
 3. Rose Brand East, www.rosebrand.com.
- B. Source Limitations: Obtain each color and pattern of drapery fabric and trim from one dye lot.
- C. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Drape:
1. Heading:
 - a. Box Pleats: 100 percent fullness.
 - b. Pleat Spacing: 12 inches on center.
 - c. Heading Accessories:
 - 1) Nonwoven buckram.
 - 2) Grommets: Brass, No. 4.
 - a) Pleated Curtains: Center grommets on each box pleat and place 1 inch from corner of curtain.
 - 3) Hooks: Manufacturer's standard heavy-duty plated S-hooks for each grommet, length as recommended by manufacturer.
 2. Drapery Fabric:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide KM Fabrics, Inc., Memorable FR Velour, 25 oz./linear yard; or a comparable product by one of the following:
 - 1) Designtex; Design Tex Group Inc. (The).
 - 2) Maharam Fabric Corporation; Herman Miller, Inc.
 - 3) Wesco Fabrics; RM COCO Decor Ltd.
 3. Fiber Content: 100 percent FR cotton.
 4. Color: To be selected by Architect from manufacturer's full range.
 5. Orientation: Run right (up the bolt).
 6. Width: 54 inches.
 7. Textile Treatments: Stain repellent; and flame retardant, polymer type.
 8. Lining Fabric:
 - a. Product: Selected by fabricator for use with drapery fabric indicated.
 - b. Weight: 16 oz./linear yard.
 - c. Color: To be selected by Architect from manufacturer's full range.

- d. Textile Treatments: Stain repellent; and flame retardant, polymer type.
- 9. Hem Weights: Tape type (string weights).

2.3 DRAPE FABRICATION

A. General:

1. Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on fabric not visible to audience.
2. Provide vertical seams unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats.
3. Do not use fabric cuts less than one-half width.
4. Orient velour fabric with the fabric nap down.
5. Mark centerline of curtain at the top of webbing and a white tie line to the corresponding grommet.

B. Fabricate drapes in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.

1. One-Way-Stacking Drapes: Add 5 inches (127 mm) to overall width for returns.
2. Center-Opening Drapes: Add 10 inches (254 mm) to overall width for overlap.

C. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are unacceptable.

D. Top Hems: Reinforce by double-stitching 3 inch wide, heavy poly webbing to top edge on back side of curtain with not less than 2 inches of face fabric turned under.

E. Side Hems: Double-turned, 1-1/2-inch- (38-mm-) wide hems consisting of three layers of fabric, and blindstitched so that stitches are invisible on face of drape.

F. Bottom Hems: Double-turned, 4-inch- (102-mm-) wide hems consisting of three layers of fabric and weighted and blindstitched so that weights and stitches are invisible on face of drape.

1. Sew in square lead weights at each seam and at panel corners.

G. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch (38-mm) return of face fabric.

1. Bottom Hem: Hem separately or blind stitch to drapery fabric as recommended by manufacturer.

PART 3 - EXECUTION

3.1 DRAPERY TRACK INSTALLATION

- A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

- B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.

3.2 DRAPE INSTALLATION

- A. Where drapes abut overhead construction, hang drapes so that clearance between headings and overhead construction is 1/4 inch (6.4 mm).

3.3 ADJUSTING

- A. After hanging drapes, test and adjust each drapery track to produce unencumbered, smooth operation.
- B. Steam and dress down drapes as required to produce crease- and wrinkle-free installation.
- C. Remove and replace drapes that are stained or soiled.

END OF SECTION 122200

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SECTION 131113 – MEDIUM ISOLATION SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this section, as shown or specified, shall be in accordance with the requirements of the Contract documents.

1.2 WORK INCLUDED

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the furnishing and installation of STC-44 Doors as shown on the drawings and specified herei

1.3 RELATED WORK

- A. Consult all other Sections to determine the extent of work specified elsewhere hut related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner.

1.4 SUBMITTALS

- A. Submit certified copies of 1/3-Octave Band Transmission Loss Test Data and STC rating for Sound Retardant Steel Doors as issued by an accredited independent Acoustical Laboratory. STC rating is assigned to specific door openings as shown on the Door Schedules.
- B. Submit Shop Drawings for fabrication and installation of door panels, door frames, hardware, and acoustical seals. Shop drawings shall include detail assembly drawings, showing the complete installation, a listing of materials, surface finishes, fabricating assembly, and installation tolerances. No Shop Drawing shall be submitted which shows details or components that deviate from those shown or described on Construction Documents. A request for deviations must be submitted in writing to Architect for review and approval.
- C. Provide a Schedule of door assemblies using the same reference numbers for details and openings as those shown on Construction Documents.
- D. Submit with proposal a Schedule indicating a comparison of the Acoustical Performance and hardware requirements of these Specifications with the Acoustical Performance and hardware offered in the proposal.

1.5 PRODUCT HANDLING

- A. Deliver hollow metal work crated to provide protection during job storage. Use all means necessary to project the material of this Section before, during and after installation and to protect the installed work and materials of all other trades. Inspect for damage prior to installation. Minor damage may be repaired on jobsite on approval; otherwise, replace damaged item.

1.6 QUALITY ASSURANCE

- A. The manufacturer of STC-45 Doors shall have a minimum 5 years experience in the fabrication and installation of acoustically rated door assemblies similar to those of this Section.
- B. Laboratory Certification: Acoustical testing of submitted doors assemblies shall be conducted in an accredited independent acoustical laboratory. Sound transmission loss values in dB in each 1/3-octave band from 100 Hz to 5000 Hz shall be determined in accordance with ASTM E90-90. Sound Transmission Class (STC) rating shall be determined in accordance with ASTM E413-87.
- C. Certification of acoustical tests must be submitted by Contractor for approval prior to installation.
- D. The Contractor shall employ an organization and personnel who are trained and skilled mechanics with previous experience in the installation of similar precision fabricated assemblies.
- E. Fabrication shall not proceed until written approval of Submittal has been issued.
- F. The force in pounds required to open and operate each door panel shall be in accordance with the requirements of the Americans with Disabilities Act.
- G. Sound Retardant Door assemblies shall be manufactured by one of the following:
 - 1. Overly Manufacturing Company, Greensburg, PA 724-834-7300
 - 2. Krieger Steel Products Company, Pico Rivera, CA 310-695-0645
 - 3. IAC Acoustics, North Aurora, IL 630.270.1790

1.7 FIELD CERTIFICATION

- A. Contractor shall guarantee acoustical performance in the field of the Sound Retardant Steel Doors. The acoustical performance rating in the field shall not be less than a Noise Isolation Class (NIC) 3 dB lower than the laboratory STC rating of the door assembly when tested in the field in accordance with the noise reduction test procedure ASTM 336-75.
- B. The field test will be conducted by the Architect's acoustical consultant. The manufacturer's representatives should be present to observe testing procedures and conditions. Approval of test data to be given by Architect or representative of Architect.
- C. The requirement that the Contractor, at the time of bidding, submit certification of STC rating as obtained in an accredited acoustical laboratory is mandatory. The guarantee of the achievement of acoustical performance of the NIC rating in the field will not be accepted as a substitute for the laboratory test certification. Complete compliance with the acoustical performance specifications, both laboratory and field, is required of the Contractor to be eligible as a bidder on the furnishing and installation of the Sound Retardant Steel Doors.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Cold rolled sheet steel: Per ASTM A366 and ASTM A568.

- B. Solid wood door leaf:
 - 1. Veneer type: Red oak, plain sliced
 - 2. Stain color: To be selected per architect from manufacturer's standard options
- C. Supports and anchors: Fabricate sheet metal (14-gauge minimum) of shapes and sizes required to secure frames to partitions and concrete floor.
- D. Shop applied paint: For all steel surfaces use rust-inhibitive type primer paint suitable for finish coat of paint applied in the field.
- E. Fabrication: Hollow metal units to be rigid and free of defects, warp, or buckle.
- F. Finish hardware preparation: Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing plates, and drilling and tapping as required. Provide reinforcing plates for surface mounted items. Weight of door panels to be considered.

2.2 REINFORCEMENT

- A. Reinforce door panels for required hardware as follows:
- B. Hinges: 3/8 in. steel plate x 6 in. longer than hinge. Secure with not less than 6 spot-welds.
- C. Mortised Latchsets with Lever Handles: 14-gauge steel sheet with not less than 2 spot-welds.
- D. Surface Mounted Closers: 12-gauge steel sheet secured with not less than 6 spot-welds.

2.3 TYPE STC-44 SOUND RETARDANT DOOR ASSEMBLY:

- A. Acoustical Performance: The acoustical performance requirements are that the door assembly (door frame, panels, and acoustical seals, including astragal) shall have not less than an STC 45 and include expanded specifications concerning sound transmission loss (TL) values in dB for each 1/3-octave band from 100 Hz to 5000 Hz, including TL at the 125 Hz 1/3-octave band.
- B. Fabrication: The steel frame shall be 14-gauge cold rolled steel, reinforced continuously at jambs and head. The frame shall be of a "slip-in" configuration and abut and terminate to specific partition construction as shown on Drawings. The sound insulating door panel shall be 1-3/4 in. thick solid wood door. The weight of door panel shall not exceed 11 psf. Vision ports to be installed in door panels where shown on Drawings and in Schedule. Provide acoustical seals equal to those installed for certification tests.
- C. Door shall be Overly Type 459573 or approved equal.

2.4 GLASS AND GLAZING

- A. Glazing in Doors shall consist of the number of lites of glass type, thickness and treatment as required by door manufacturer to achieve the specified acoustical performance of the door assembly but shall in no case have a lower acoustical performance than laminated acoustical glass, consisting of two lites, each 1/4 in. thick laminated acoustical glass.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to all work of this Section, carefully inspect the installed work of all other trades, and verify that all is complete to the point where this installation may properly commence. Verify that Door Assemblies may be installed in complete accordance with the original design and the approved Shop Drawings. In the event of discrepancy, immediately notify the Architect in writing.
- B. Shop prefabricates all doors and frames into complete units, verifying all measurements at the site prior to fabrication. Knockdown frames shall not be approved.
- C. Fabricate in strict accordance with approved Shop Drawings. Accurately miter and fit all members to hairline joints. Weld or mechanically fasten along entire line of contact on the unexposed side.
- D. Install units in accordance with manufacturer's recommendations. The manufacturer shall provide a trained engineer or mechanic at the jobsite to supervise the unloading, erection, final adjustments, and final check out of the Door Assemblies, including door panels, frames, hardware, and accessories.
- E. Back of steel frame shall be packed solid with minimum 6 pcf mineral wool batt insulation prior to installation when installed in drywall partition or filled with grout prior to installation when installed in block partition.
- F. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
- G. Tightly caulk openings between steel frame and adjoining partition with clear silicone sealant.
- H. Door frames shall be delivered to jobsite with a steel spreader connecting the bottom legs of the frame to ensure non-racking. Spreader does not determine the opening width.
- I. Fit doors accurately in frames with clearances recommended by the manufacturer.
- J. Apply clear silicone sealant to all jamb and head seals prior to application of seals to frame.
- K. Check and readjust the operating finish hardware items just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed or otherwise unacceptable.

END OF SECTION 131113

SECTION 133473 – HIGH ISOLATION SOUND CONTROL DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this section, as shown or specified, shall be in accordance with the requirements of the Contract documents.

1.2 WORK INCLUDED

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the furnishing and installation of Sound Control Door Assemblies as shown on the drawings and specified herein

1.3 RELATED WORK

- A. Consult all other Sections to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner.

1.4 SUBMITTALS

- A. Submit certified copies of 1/3 Octave Band Transmission Loss test data and STC rating as issued by an accredited independent acoustical laboratory.
- B. Submit Shop Drawings for fabrication and installation of door panels, door frames, hardware, and acoustical seals. Shop drawings shall include detail assembly drawings, showing the complete installation, a listing of materials, surface finishes, fabricating assembly and installation tolerances. No Shop Drawing shall be submitted which shows details or components that deviate from those shown or described on Construction Documents. A request for deviations must be submitted in writing to Architect for review and approval.
- C. Provide a Schedule of door assemblies using the same reference numbers for details and openings as those shown on Construction Documents.
- D. Submit with proposal a Schedule indicating a comparison of the Acoustical Performance and hardware requirements of these Specifications with the Acoustical Performance and hardware offered in the proposal.

1.5 PRODUCT HANDLING

- A. Deliver hollow metal work crated to provide protection during job storage. Use all means necessary to protect the material of this Section before, during and after installation and to protect the installed work and materials of all other trades. Inspect for damage prior to installation. Minor damage may be repaired on jobsite on approval; otherwise, replace damaged item.

1.6 QUALITY ASSURANCE

- A. The manufacturer of Sound Control Door Assemblies shall have a minimum 5 years experience in the fabrication and installation of acoustically-rated door assemblies similar to those of this Section.
- B. Laboratory Certification: Acoustical testing of submitted door assemblies shall be conducted in an accredited independent acoustical laboratory. Sound transmission loss values shall be determined in accordance with ASTM E90-90. Sound Transmission Class (STC) shall be determined in accordance with ASTM E413-87.
- C. Certification of acoustical tests must be submitted by Contractor for approval prior to installation.
- D. The Contractor shall employ an organization and personnel who are trained and skilled mechanics with previous experience in the installation of similar precision fabricated assemblies.
- E. Fabrication shall not proceed until written approval of Submittal has been issued.
- F. The force in pounds required to open and operate each door panel shall be in accordance with the requirements of the Americans with Disabilities Act.
- G. Sound Control Door assemblies shall be manufactured by one of the following:
 - 1. IAC Acoustics
 - 2. Noise Barriers, LLC

1.7 FIELD CERTIFICATION

- A. Contractor shall guarantee acoustical performance in the field of the Sound Control Door Assemblies. The acoustical performance rating in the field shall not be less than a Noise Isolation Class (NIC) 5 points lower than the laboratory STC rating of the door assembly when tested in the field in accordance with the noise reduction test procedure ASTM 336-75.
- B. The field test will be conducted by the Architect's acoustical consultant. The manufacturer's representatives should be present to observe testing procedures and conditions. Approval of test data to be given by Architect or representative of Architect.
- C. The requirement that the Contractor, at the time of bidding, submit certification of STC rating as obtained in an accredited acoustical laboratory, is mandatory. The guarantee of the achievement of acoustical performance of the NIC rating in the field will not be accepted as a substitute for the laboratory test certification. Complete compliance with the acoustical performance specifications, both laboratory and field, is required of the Contractor to be eligible as a bidder on the furnishing and installation of the Sound Control Door Assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fabricate units to be rigid, neat in appearance and free from defects, warp, or buckle. Accurately form metal to required sizes and profiles. Wherever practical, fit and assemble units in the manufacturer's plant. Identify work that is not permanently factory-assembled before shipment to ensure proper

assembly at the Project site. Weld exposed joints continuously: grind, fill dress and make smooth flush and invisible.

- B. Cold rolled sheet steel: Per ASTM A366 and ASTM A568.
- C. Wood veneer door leaf finish:
 - 1. Veneer type: Red oak, plain sliced
 - 2. Stain color: To be selected per architects from manufacturer's standard options
- D. Supports and anchors: Fabricate not less than 14-gauge sheet metal of shapes and sizes required to secure frames to partitions and concrete floor. Provide jamb anchors as determined by wall construction. Anchors are to be spaced at 12 in. on center (max) and are to be of a corrosion resistant material.
- E. Frames: Frames shall be slip-in configuration, continuously reinforced, fabricated from 14 gauge cold rolled, galvanized steel with an A60 coating weight and furnished "split" in two (2) pieces, inside and outside, that are mitered and welded together allowing for easy installation into either existing or new construction openings.
- F. Shop applied paint: For all steel surfaces use rust-inhibitive type primer paint suitable for finish coat of paint applied in the field.
- G. Fire Rating: As specified below or as shown on Drawings.
- H. Fabrication: Steel units to be rigid and free of defects, warp, or buckle.

2.2 HARDWARE

- A. Hinges: Cam-lift, butt-type, hinges, US26D finish by door manufacturer. Hinge manufacturer to furnish laboratory test data on request certifying that hinges of identical design have been cycled a minimum of 125,000 times while supporting a door leaf weighing a minimum of 350 lbs.
 - 1. Quantity of hinges as follows:
 - a. For door leaf thickness less than or equal to 2 ½ in.:
 - 1) Two (2) hinges required per leaf for openings up to and including 96 in. high.
 - 2) Three (3) hinges required per leaf for openings up to and including 120 in. high
- B. Closers: "LCN" or "Norton"
- C. Pull Handles: 1 in. diameter x 9 in. overall length, 3 in. projection, US28 finish
- D. Push Plates: 4 in. wide x 16 in. high x .050 in. thick, US32D finish
- E. Latchsets/Locksets: Provided by door supplier. Refer to finish hardware schedule for details
- F. Flushbolts: "Glynn-Johnson", surface mounted to inactive leaf, top & bottom (used on double leaf doors)
- G. Coordinators: "Dorma" (used on double leaf doors when both leaves need to be active)
- H. Thresholds: Thresholds shall be ungrooved solid metal or wood. Thickness shall match finish floor height. Finish to be selected by architect.

- I. Finish hardware preparation: Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing plates, and drilling and tapping as required. Provide reinforcing plates for surface mounted items. Weight of door panels to be considered.

2.3 PRE-HUNG

- A. Assembly and adjustment of door leaf, frame, acoustic seals, hinges, and associated finish hardware shall take place at the factory to insure ease of installation, reliable operation, and acoustic performance. The entire manufactured assembly shall be shipped to the job site ready to install and operate.

2.4 REINFORCEMENT

- A. Reinforce door panels for required hardware as follows:
- B. Hinges: 3/8 in. steel plate x 6 in. longer than hinge. Secure with not less than 6 spot-welds.
- C. Mortised Latchsets with Lever Handles: 14-gauge steel sheet with not less than 2 spot-welds.
- D. Surface Mounted Closers: 12-gauge steel sheet secured with not less than 6 spot-welds.

2.5 TYPE STC-51 SOUND CONTROL DOOR ASSEMBLY:

- A. Acoustical Performance: The acoustical performance requirements are that the door assembly (door frame, panel, and acoustical seals) shall have not less than an STC 51 and include expanded specifications concerning sound transmission loss (TL) values in dB for each 1/3-octave band from 100 Hz to 5000 Hz, including TL at the 125 Hz 1/3-octave band which shall be a minimum 28dB.
- B. Fabrication: The steel frame shall be 14-gauge cold rolled steel, reinforced continuously at jambs and head. The frame shall be of a "slip-in" configuration and abut and terminate to specific partition construction as shown on Drawings. The sound insulating door panel shall be 2 ½ in. thick, having cold rolled 14-gauge steel panel facings and continuously welded edges, and finished with wood veneer. The door shall be provided with a mortised astragal where scheduled on the drawings. The weight of door panel shall not exceed 9 psf. Vision ports to be installed in door panels where shown on Drawings and in Schedule. Provide integral double magnetic acoustical seals equal to those installed for certification tests.
- C. Door shall be one of the following, or approved equal:
 - 1. IAC Acoustics Type "Noise Lock 51"
 - 2. Noise Barriers Type "QS-51"

2.6 GLASS AND GLAZING

- A. Laminated Acoustical Glass
 - 1. Glass shall meet minimum requirements as specified in ASTM C1036-85.
 - 2. Interlayer shall be clear Saflex by Monsanto.

3. Acoustical Performance: Laminated acoustical glass shall have not less than the STC values shown below, and include expanded specifications concerning sound transmission loss (TL) values in dB for each 1/3 octave band from 100 Hz to 5000 Hz, including TL at the 125 Hz 1/3 octave band which shall be no less than the values indicated below:

Glazing Thickness	STC TL at 125 Hz	
¼ in.	36	27
½ in.	38	29
¾ in.	41	30

- B. Glazing in Doors shall consist of the number of lites of glass type, thickness and treatment as required to achieve the specified acoustical performance of the door assembly but shall in no case consist of fewer than two lites, each ¼ in. thick laminated acoustical glass.
- C. Glazing channel shall be closed cell sponge EPDM glazing channel. Extruded U-channels by Atlantic India Rubber (219-534-1531) or approved equal.
- D. Non-Fire Rated Doors: Provide factory-installed, aluminum extruded stops and moldings with true mitered corners for double, glazed assemblies. Size of vision lite is to be determined from the door schedule. Safety glass or fire-resistive glazing product meeting doors' sound control and labeling requirements is acceptable.
- E. Fire Rated Doors: Provide factory-installed, formed steel stops and moldings with true mitered corners for double, glazed assemblies. Size of vision lite is to be determined from the door schedule in conjunction with any UL requirements. Wire mesh, glass clad laminate or fire-resistive glazing product meeting doors' sound control and labeling requirements is acceptable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prior to all work of this Section, carefully inspect the installed work of all other trades, and verify that all is complete to the point where this installation may properly commence. Verify that Door Assemblies may be installed in complete accordance with the original design and the approved Shop Drawings. In the event of discrepancy, immediately notify the Architect immediately in writing.
- B. Shop prefabricate all doors and frames into complete units, verifying all measurements at the site prior to fabrication. Knock-down frames shall not be approved.
- C. Rough openings shall be constructed square and plumb to within 1/8 in. deviation, or as stipulated by the door manufacturer. Floor flatness and levelness within 6 feet in any direction from the doorway rough opening shall conform to a flatness/levelness criterion of FF45/FL35.
- D. Fabricate in strict accordance with approved Shop Drawings. Accurately miter and fit all members to hairline joints. Weld or mechanically fasten along entire line of contact on the unexposed side.
- E. Install units in accordance with manufacturer's recommendations. The manufacturer shall provide a factory-trained engineer or mechanic at the jobsite to supervise the unloading, erection, final

adjustments, and final check out of the Door Assemblies, including door panels, frames, hardware, and accessories.

- F. Back of steel frame shall be packed solid with minimum 6 pcf mineral wool batt insulation prior to installation when installed in drywall partition or filled with grout prior to installation when installed in block partition.
- G. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
- H. Tightly caulk openings between steel frame and adjoining partition with clear silicone sealant.
- I. Door frames shall be delivered to jobsite with a steel spreader connecting the bottom legs of the frame to ensure non-racking. Spreader does not determine the opening width.
- J. Fit doors accurately in frames with clearances recommended by the manufacturer.
- K. Apply clear silicone sealant to all jamb and head seals prior to application of seals to frame.
- L. Check and readjust the operating finish hardware items just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed or otherwise unacceptable.

END OF SECTION 133473

SECTION 142123.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Machine-room-less electric traction service elevators.

1.2 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.
3. Power information: separate data sheets for horsepower, starting current, running current, machine and control heat release, and electrical requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For each type of exposed finish involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard two-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.8 COORDINATION

- A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

1.9 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Schindler Elevator Corp; **MRL 5500, 5000 lb capacity, 200 FPM hospital service elevator**, or a comparable product by one of the following:
 1. Otis Worldwide Corporation.
 2. ThyssenKrupp Elevator.
- B. Source Limitations: Obtain elevators from single manufacturer.
 1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator seismic requirements in ASME A17.1/CSA B44.
 1. Project Seismic Design Category: As indicated in Drawings.
 2. Elevator Component Importance Factor: 1.0.
 3. Design earthquake spectral response acceleration short period (Sds) for Project is as indicated in Drawings.
 4. Provide earthquake equipment required by ASME A17.1/CSA B44.

2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 1. Rated Load: 5000 lb (2270 kg).
 2. Freight Loading Class for Service Elevator(s): Class A.
 3. Rated Speed: 200 fpm (1.0 m/s).
 4. Operation System: Microprocessor Single Car automatic operation.

5. Auxiliary Operations:
 - a. Battery-powered automatic evacuation.
 - b. Automatic operation of lights and ventilation fans.
6. Security Features: Keyswitch operation.
7. Car Enclosures:
 - a. Inside Width: Not less than 74 inches from side wall to side wall.
 - b. Inside Depth: Not less than 100 inches from back wall to front wall (return panels).
 - c. Inside Height: Not less than 92 inches to underside of ceiling.
 - d. Front Walls (Return Panels): Satin stainless steel, ASTM A480/480M, No. 4 finish.
 - e. Car Fixtures: Satin stainless steel, ASTM A480/480M, No. 4 finish.
 - f. Side and Rear Wall Panels: Satin stainless steel, ASTM A480/480M, No. 4 finish .
 - g. Reveals: Satin stainless steel, ASTM A480/480M, No. 4 finish.
 - h. Door Faces (Interior): Satin stainless steel, ASTM A480/480M, No. 4 finish .
 - i. Door Sills: Nickel silver.
 - j. Ceiling: LED downlight drop ceiling; Satin stainless steel, ASTM A480/480M, No. 4 finish.
 - k. Handrails: 1/2 by 2 inches (13 by 50 mm) rectangular satin stainless steel, at sides and rear of car.
 - l. Floor prepared to receive resilient flooring (specified in Section 096519 "Resilient Tile Flooring").
8. Hoistway Entrances:
 - a. Width: 54 inches (1372 mm).
 - b. Height: 84 inches (2134 mm).
 - c. Type: Two-speed side sliding.
 - d. Frames Satin stainless steel, ASTM A480/480M, No. 4 finish.
 - e. Doors: Satin stainless steel, ASTM A480/480M, No. 4 finish .
 - f. Sills at Other Floors: Nickel silver.
9. Hall Fixtures: Satin stainless steel, ASTM A480/480M, No. 4 finish.
10. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, ASTM A480/480M, No. 4 finish.
 - b. Provide hooks for protective pads and one complete set of full-height protective pads.

2.4 TRACTION SYSTEMS

- A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
 1. Provide regenerative system.
 2. Provide regenerative system that complies with the IgCC.
 3. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
 4. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- B. System Configuration: Machine Room Less (MRL) Side Counterweight

- C. Fluid for Hydraulic Buffers: Fire-resistant fluid.
- D. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- E. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- F. Car Frame and Platform: Bolted- or welded-steel units.
- G. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

- A. Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Auxiliary Operations:
 - 1. Single-Car Battery-Powered Automatic Evacuation: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it moves to the next floor above or below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.
 - 2. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after five minutes and are re-energized before car doors open.
- C. Security features shall not affect emergency firefighters' service.
 - 1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations and hall push-button stations. Key is removable only in deactivated position. Keyswitch to control all floor levels.

2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

- A. Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
1. Subfloor:
 - a. Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
 2. Floor Finish:
 - a. As indicated in Drawings.
 3. Stainless Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless steel sheet.
 4. Fabricate car with recesses and cutouts for signal equipment.
 5. Fabricate car door frame integrally with front wall of car.
 6. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet.
 7. Sight Guards: Provide sight guards on car doors.
 8. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 9. Metal Ceiling: Flush panels, with four low-voltage downlights in each panel. Align ceiling panel joints with joints between wall panels.
 10. Light Fixture Efficiency: Not less than 35 lumens/W.
 11. Ventilation Fan Efficiency: Not less than 3.0 cfm/W (1.4 L/s per W).

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
1. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
1. Stainless Steel Frames: Formed from stainless steel sheet.
 2. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both jambs of hoistway door frames.
 3. Stainless Steel Doors: Flush, hollow-metal construction; fabricated from stainless steel sheet .
 4. Sight Guards: Provide sight guards on doors matching door edges.
 5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 6. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

2.9 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed flush car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 - 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28.
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing.
 - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - 2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
 - 3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 28.
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
 - 1. Units mounted in both car door jambs.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 - 1. At manufacturer's option, audible signals may be placed on cars.
- I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate and with body of unit recessed in wall.
 - 1. Integrate ground-floor hall lanterns with hall position indicators.
- J. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless

otherwise indicated. Provide all signs as related to the elevator, as required by authorities having jurisdiction.

- K. Provide interface for CCTV.

2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- D. Stainless Steel Bars: ASTM A276, Type 304.
- E. Stainless Steel Tubing: ASTM A554, Grade MT 304.
- F. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500 or UNS No. C77600.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

- F. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and travel direction.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
 - 1. Place hall lanterns either above or beside each hoistway entrance.
 - 2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:
 - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
 - 2. Provide strippable protective film on entrance and car doors and frames.
 - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
 - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 5. Do not load elevators beyond their rated weight capacity.
 - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
 - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, elevator(s).
- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during normal working hours.
 - 2. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of 8 hours or less.
- B. Submit a continuing maintenance proposal from Installer to Owner to extend service for two-years, starting on date initial maintenance service is concluded.

END OF SECTION 142123.16

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SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

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SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes pipe, fittings, valves, and connections for combination sprinkler and standpipe systems.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.11 - Forged Steel Fittings - Socket-Welding and Threaded.
 - 3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 5. ASME B16.25 - Buttwelding Ends.
 - 6. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 7. ASME B16.4 - Gray Iron Threaded Fittings.
 - 8. ASME B16.5 - Pipe Flanges and Flanged Fittings.
 - 9. ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings.
 - 10. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
- B. ASTM International:
 - 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A135 - Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - 3. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 4. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - 5. ASTM B32 - Standard Specification for Solder Metal.
 - 6. ASTM B75 - Standard Specification for Seamless Copper Tube.
 - 7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 8. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
- C. American Welding Society:
 - 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

2. AWS D1.1 - Structural Welding Code - Steel.
- D. American Water Works Association:
 1. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
 2. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 3. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- E. National Fire Protection Association:
 1. NFPA 13 - Installation of Sprinkler Systems.
 2. NFPA 14 - Standard for the Installation of Standpipe, Private Hydrants and Hose Systems.
 3. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Product Data: Submit manufacturer's catalogue information. Indicate valve data and ratings.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and tag numbering.
- C. Operation and Maintenance Data: Submit spare parts lists.

1.6 QUALITY ASSURANCE

- A. Provide fire sprinkler piping located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with UL 1887.
- B. Perform Work in accordance with NFPA 13 standard.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

- C. All hydraulic calculations are to be based on a water test completed within one calendar year of when project is to begin construction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. Furnish cast iron and steel valves with temporary protective coating.
- D. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for basic fire suppression materials and methods.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 VALVES

- A. Gate Valves:
 - 1. Up to and including 2 inches: Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid [rubber covered] bronze or cast iron wedge, [flanged] [grooved] ends.
 - 3. Over 4 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.
- B. Check Valves:
 - 1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends.
 - 2. Over 2 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends.
 - 3. 4 inches and over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.
- C. Drain Valves:
 - 1. Compression Stop: Bronze with hose thread nipple and cap.
 - 2. Ball Valve: Brass with cap and chain, 3/4 inch hose thread.

2.2 ABOVE GROUND PIPING

- A. Aboveground Piping:
 - 1. Up to and including 2-inch: Schedule 40; Type E, Grade B or Type S, Grade B.

2. 2-1/2-inch and larger: Schedule 40; Type E, Grade B or Type S, Grade B.
 - a. Note - 2-1/2-inch and larger: Schedule 40; Type E, Grade B or Type S, Grade B may be used for risers only. Prior to design or use the A/E and/or Contractor is to obtain approval from University Facilities and provide documentation for cost savings.
- B. Aboveground Pipe Fittings:
 1. Up to and including 2-inch: Threaded.
 2. 2-1/2 inch and larger: Grooved.
 3. Branch connections:
 - a. Weldolet and sockolet fittings are allowed on schedule 40 pipe.
 - b. Merchant couplings and non-reinforced type fittings are prohibited.
- C. Aboveground Pipe Welding:
 1. Welding of schedule 10 pipe is prohibited.
 2. Welding of Schedule 40 pipe 2-inch and smaller is prohibited.
 3. Schedule 40 pipe 2-1/2 inch and larger is to be socket or butt welded.

2.3 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 13.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- I. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.4 FIRESTOPPING

- A. Firestopping Materials: Comply with requirements of Section 07 84 00.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Single component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.

4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: As selected from manufacturer's full range of color.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 1. Install in accordance with NFPA 13.
 2. Install hangers to with minimum 1/2 inch space between finished covering and adjacent work.
 3. Place hangers within 12 inches of each horizontal elbow.
 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.
 7. Install sheet lead packing between hanger or support and piping.
- G. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.

- H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.
- I. Do not penetrate building structural members unless indicated.
- J. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.
- K. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- L. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- M. Install gate valves for shut-off or isolating service.
- N. Install drain valves at main shut-off valves, low points of piping and apparatus.
- O. Install the sprinkler system per FM Global Property Loss Prevention Data Sheet 2-0, Installation Guidelines for Automatic Sprinklers.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean entire system after other construction is complete.

END OF SECTION 210500

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SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

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SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes entire standpipe system from fire department connection to fire hose connection.
- B. Related Sections:
 - 1. Section 21 05 00 - Common Work Results for Fire Suppression: Product and execution requirements for pipe, fittings, valves, hangers, supports, identification and painting for placement by this section.

1.3 REFERENCES

- A. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- B. National Fire Protection Association:
 - 1. NFPA 14 - Standard for the Installation of Standpipe, Private Hydrants and Hose Systems.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate supports, components, accessories, and sizes.
- C. Product Data: Submit manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.
- D. Field Test Reports: Indicate compliance with specified performance.
- E. Manufacturer's Installation Instructions: Submit with product data.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit servicing requirements and test schedule.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 14.
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver and store products in shipping packaging until installation.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 FIRE HOSE CABINETS

- A. Manufacturers
 - 1. Potter Roemer
 - 2. Substitutions: Section 01 60 00 - Product Requirements
- B. Hose Cabinets:
 - 1. Style: Recessed and Surface mounted. Fire rated when installed in fire rated assemblies.
 - 2. Tub: 20 gage thick steel, prepared for pipe and accessory rough in.

- 3. Door: 20 gage thick steel, flush, full glass with clear tempered safety glass, hinged, positive latch device.
- 4. Finish: Powder-coated with an electrostatically-applied, thermally-fused, recoatable white polyester finish.
- C. Hose Rack: Steel; swivel type with pins and water stop.
- D. Hose: 1-1/2 inch diameter, 75 feet long, of rubber lined synthetic hose; mildew and rot-resistant.
- E. Nozzle: Chrome plated brass; combination fog, straight stream, and adjustable shut-off.
- F. Fire Department Valve: 2-1/2" angle brass.

2.2 FIRE DEPARTMENT CONNECTION

- A. Type: Free standing type with ductile iron pedestal polished chrome manufacturer Croker.
- B. Outlets: Storz universal Threadless with cap
- C. Drain: 3/4 inch automatic drip, outside.
- D. Label: "Dry Standpipe".

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify blocking in place for cabinet installation.

3.2 INSTALLATION

- A. Install in accordance with NFPA 14.
- B. Install cabinets plumb and level. Secure to adjacent surfaces. Establish top of cabinet inside horizontal per NFPA-14 requirements above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Test entire system in accordance with NFPA 14.
- B. Require test be witnessed by Authority having jurisdiction.

3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Flush entire system of foreign matter.

END OF SECTION 211200

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 INSTRUCTIONS AND GENERAL REQUIREMENTS

- A. These specifications and accompanying drawings are intended to cover the furnishing of all labor, material, and equipment and superintendence of the plumbing system of the indicated project.
- B. The word "Owner" shall mean West Point Association of Graduates (WPAOG) of the USMA or their representative on this Project.
- C. The word "Contractor" shall mean the Contractors responsible for the Mechanical, Plumbing, Fire Protection and Electrical Work and who shall perform the work as described herein and indicated on the drawing with respect to the trade.
- D. The word "Design Professional" or "The Design Professional" shall mean the Architect and/or Engineer.
- E. The term "Furnish" shall mean to obtain and supply to the job site. The term "Install" shall generally mean to fix in position and connect for use. Where language indicates that one party or trade is to "install" and another is to "connect", the term "install" shall mean only to fix in position, and "connect" shall mean to make final connections to. The term "Provide" shall mean to furnish and install.
- F. It is the intent and purpose of these specifications and accompanying drawings to cover and include each item, all materials, machinery, apparatus, and labor necessary to properly install, equip, adjust, and put into perfect operation the respective portions of the installations specified and to so interconnect the various items or sections of the work as to form a complete and properly operating whole.
- G. Any equipment, apparatus, machinery, material and small items not mentioned in detail, and labor not hereinafter specifically mentioned, which may be found necessary to complete or perfect any portion of installation in a substantial manner, and in compliance with the requirements stated, implied or intended in these specifications shall be furnished without extra cost. This shall include all materials, devices or methods peculiar to the machinery, equipment, apparatus, or systems furnished and installed as part of the Plumbing Work.

- H. Drawings and specifications have been prepared with best knowledge of conditions available at the time of design. If any obscurities or discrepancies exist, they shall be brought to the attention of the Design Professional before bids are submitted. If they are not discovered before bids are submitted, the Design Professional shall be notified and shall render decision. This decision shall be final.
1. Drawings and Specifications are intended to be complementary; items described or shown in one but not both are to be furnished as if fully shown or described in both locations.
- I. The Contractor shall carefully examine all drawings, specifications and contract documents, and the site before submitting his proposal for this work. The Contractor shall compare the site with drawings, specifications and contract documents for all other branches of the work. He shall include in his proposal any monetary sums which he may deem necessary to cover the difficulties and/or costs for furnishing and installing complete all of the work shown on the drawings, the specifications and/or implied therein.
- J. It is the intent of the Contract Documents to describe a functionally complete Project to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.
- K. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated in the Contract Documents.
- L. Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to The Design Professional any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from The Design Professional before proceeding with any Work affected thereby.
- M. If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to The Design Professional in writing.
- N. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and The Design Professional, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of The Design Professionals, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible, or by Owner.
- O. The Design Professional will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the

performance of the Work, will be referred initially to The Design Professional in writing within 30 days of the event giving rise to the question

- P. The Design Professional will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- Q. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish The Design Professional the required certificates of inspection or approval.
- R. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and The Design Professional's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and The Design Professional.

1.3 NOISE AND VIBRATION CONTROL

- A. Noise control shall be provided to maximize the usefulness of the facility by maintaining reverberation times and background sound levels within ranges that are appropriate for the intended use of the facility.
- B. Noise control shall be in compliance with OSHA requirements for the health and safety of building occupants; control shall be for all areas of the facility, particularly equipment rooms, PRV stations, and fan rooms.
- C. Provide vibration control to limit sound produced by equipment and for protection of equipment and the building structure.
- D. ANSI Standards shall be used as the basis for defining goals for appropriate reverberation times and acoustical isolation of various types of spaces.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall, before submitting his proposal, visit the site of the work and acquaint himself with all conditions relevant to the work and its surroundings. The Contractor shall carefully investigate to determine any variances between actual conditions at site as shown or represented in the specifications or drawings. Anything in the contract documents or any representations, statements, or information made or furnished by The Design Professional notwithstanding, the Contractor shall, regardless of any such conditions relevant to the work, the site of work or its surroundings, assume full and complete responsibility thereof, and all risk in connection therewith at no additional cost to the Owner.
- B. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

- C. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and The Design Professional except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.
- D. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.
- E. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by The Design Professional, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- F. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

1.5 CODES, RULES, PERMITS, FEES, AND STANDARDS

- A. All work described in this specification shall be done in accordance with any applicable Federal, State and Local Codes, Laws, Ordinances, Rules and Regulations governing work of this type and the Philadelphia Plumbing Code.
- B. The Contractor shall give all necessary notices, obtain all permits and pay all governmental taxes, fees, deposits and other costs in connection with his work. He shall file all necessary plans, prepare all documents and obtain all required Certificates of Inspection and Approval for his work, including those for occupancy, and deliver same to The Design Professional before request for acceptance and final payment for the work.
- C. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, drawings, in addition to Contract Drawings and Documents in order to comply with all applicable Codes, Laws, Ordinances, Rules and Regulations, whether or not shown on Drawings and/or Specifications.
- D. Nothing stated or shown in the Contract Specifications and Drawings is intended to conflict with the above regulations. Should the Contractor find any apparent conflict, it shall be his responsibility to notify the Architect before any work in question is performed or materials purchased.
- E. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of The Design Professionals, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work.

- F. All materials furnished and all work installed shall comply with the following rules, codes, and standards:

New York State Building Codes including:

2020 Building Code of New York State: IBC 2018 w/Amendments

2020 Existing Building Code of NYS: IEBC 2018 w/Amendments

ASHRAE

ANSI

ASME

ASTM

UL

AMCA

ARI

NEC

IBC (2018)

IMC (2018)

Equipment Standards of ACRMA

PECO

NFPA

Recommendations of the Fire Insurance Rating Organization having jurisdiction.

Requirements of all government departments and agencies having jurisdiction.

- G. All package equipment shall be independently third party labeled as a system for its intended use by a nationally recognized testing laboratory in accordance with OSHA 29CFR 1910, NEC, and NFPA.

1.6 ABBREVIATIONS

- A. The following is a description of the abbreviations used herein:

AC	Alternating Current
ACRMA	Air conditioning & Refrigerating Machinery Assoc., Inc.
AIEE	American Institute of Electrical Engineers
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating & Air Conditioning Engineers
ASA	American Standards Association
ASTM	American Society of Testing Materials
AWG	American Wire Gauge Size
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NFC	National Fire Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Association
U.L.	Underwriters' Laboratories, Inc.
IBC	International Building Code
IMC	International Mechanical Code

- B. Refer to the drawings for other symbols and abbreviations.

1.7 WORKMANSHIP

- A. All work under this Contract shall be properly coordinated with the work of all trades and separate Contractors with which it comes in contact.
- B. All work under this Contract shall be installed in a first-class, neat and workmanlike manner satisfactory to The Design Professional by experienced and skilled mechanics of the trade involved.
- C. All material and equipment shall be new and shall conform to the grade, quality, and standards specified herein in every detail.
- D. All materials and equipment shall be made in the USA.
- E. All equipment offered under these specifications shall be limited to products regularly produced and recommended for the specified service. Ratings shall be in accordance with the Design Professional's data or other comprehensive literature made available to the public and in effect at this time.
- F. Equipment shall be installed in strict accordance with the manufacturer's instructions for type and capacity of each piece of equipment used. Contractor shall obtain these instructions and they shall be considered a part of these specifications. Type, capacity, and applications of equipment shall be suitable and shall operate satisfactorily for the purpose intended in the system.
- G. All equipment, materials, and devices for which label service is available, shall bear the label of the Underwriters Laboratories, Inc.

1.8 OPERATING INSTRUCTIONS

- A. Provide to the Owner three bound copies of complete written instruction on the operation, care and maintenance of each piece of equipment and the installation as a whole. Include frequency of inspection, cleaning and adjusting and other attention as may be required in accordance with manufacturer's instructions. Material shall be manufacturer's brochures, catalog cuts, parts lists, wiring diagrams, etc. Also supply Owner's with three complete sets of approved shop drawings.
- B. The instructions shall be prepared by section, labeled and include detailed parts list data and the name, address and phone number of the nearest supply source.
- C. The manuals must provide all the information required to run the building efficiently. Provide description of all the equipment operation. The materials submitted must include installation manuals, repair manuals, programming manuals, troubleshooting manuals, and parts manuals.
- D. The manufacturer's specifications sheets, if generalized in any way, will be clearly marked to show exactly which item has been supplied, and the job designation for that item (e.g. PRV-1) will be noted on manufacturer's specification sheet which includes all details for this unit including the complete model number, motor hp, voltage, etc.
- E. If there are differences between pieces of equipment, then include a specification sheet for each, properly marked.

- F. Provide one section for preventive maintenance procedures.
- G. Provide lubrication diagrams and procedures.
- H. Include Contractor's phone numbers and any other reference required to obtain warranty service.
- I. Furnish qualified personnel to instruct the Owner's personnel in the maintenance and operation of all equipment and systems. Instructing personnel shall remain on the job continuously during working hours until such instruction is complete, but not less than 16 hours.

1.9 CORRECTION OF WORK AFTER FINAL PAYMENT AND GUARANTEE

- A. Comply as applicable with Section 01 20 00 – Price and Payment Procedures.
- B. Final payment shall not relieve the Contractor of responsibility for faulty equipment, materials and workmanship and unless otherwise specified he shall remedy any defects due thereto and pay for damage to other work resulting therefore, which shall appear within a period of one (1) year from the date of acceptance.
- C. Include guarantees by the respective equipment manufacturers which shall be subject to the terms and time limits defined under this section.
- D. Guarantees furnished by Subcontractor and/or equipment manufacturers shall be counter-signed by the related Prime Contractor for joint and/or individual responsibility for subject item.
- E. Manufacturer's equipment guarantees or warranties extending beyond the guarantee period described herein shall be transferred to the Owner along with the Contractor's guarantees.

1.10 SUPERINTENDENCE

- A. The Contractor shall give his personal superintendence to the work or shall have a competent superintendent, satisfactory to The Design Professional, and the Owner, present at all times during construction with authority to act for him. The Contractor shall also provide an adequate staff for the proper installation, coordination and expediting of his work.

1.11 SCAFFOLDING, RIGGING, HOISTING

- A. The Contractor shall furnish all scaffolding, staging, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished or installed by him and shall remove same from premises when no longer required.
- B. Scaffolding and staging construction and maintenance shall be in strict accordance with all applicable codes and regulations including Contractor's safety regulations. The structure shall be erected so as not to interfere with the work of others. If it becomes necessary to move the scaffolding and/or staging to permit installation of other work, the Contractor shall do so at his own expense.
- C. Scaffolding, staging and hoisting equipment shall not be supported from piping, conduits or other equipment.

- D. Each Contractor will be responsible for providing all materials, equipment supports, supplies and labor necessary to support and brace and strengthen equipment according to industry trade standards and approved materials provided under his contract.

1.12 ROOF PROTECTION

- A. Provide adequate roof protection during the construction phase and remove same after the work is completed. Any damage to the roof surface will be repaired at the expense of the Contractor.

1.13 SUPPORT STEEL AND MISCELLANEOUS STEEL WORK

- A. The Contractor shall provide all necessary miscellaneous steel required for the installation and support of the work under this contract. Work shall include but not be limited to piping supports, equipment supports, etc. Perform all rigging required to set the equipment in place.
- B. Unless otherwise indicated, all structural steel shall be ASTM-A36 with hot dipped galvanized finish. Welds shall be finished with (2) coats of zinc rich paint.

1.14 AS-BUILT DRAWINGS

- A. The Contractor shall keep on the job a separate set of drawings on which he shall make a record of any changes in location, size or other details or installation not covered by supplemental or detail drawings. Such records shall be made at the time the changes in the work are made so that at any time the marked drawings indicate the true condition of the work. He shall record the exact dimensioned locations, grades, elevations and sizes of all underground and under floor slab conduit and piping. Dimensions shall be distance from columns, finished building surfaces, curbs and finished grade lines. At the completion of the work the marked drawings shall be transferred to AutoCAD 2011 (or later) drawings and the drawing files shall be forwarded to The Design Professional.

1.15 PAINTING

- A. Generally, all painting shall be performed by this Contractor unless otherwise indicated.

1.16 GUARANTEE

- A. All equipment and components of all systems furnished under this Contract shall be guaranteed to perform trouble free for a period of one year from the date of final acceptance of installation by The Design Professional. Any equipment that has been in operation prior to the date of acceptance shall also be guaranteed to be free of defects and perform without failures for a period of one year after the date of final acceptance. Any corrections and adjustments to the systems, replacement of equipment or parts during the guarantee period shall be furnished by the Contractor, at no additional cost to Owner.
- B. During the one (1) year guaranty period the Contractor shall make a minimum of two (2) visits to the site (6 months after acceptance and immediately prior to the end of the guarantee period). During each visit, the Contractor shall thoroughly check all equipment for proper operation. Reports shall be generated and forwarded to the Owner describing the systems inspected, date of inspection, and status of equipment.

1.17 SCHEDULING OF WORK

- A. The scheduling of any work affecting existing installations or facilities, shall be coordinated with the Owners' representative. Shut-down of utilities or equipment affecting operations of any existing part of the building will not be permitted except as provided below. Any premium time or additional cost to comply shall be at the expense of the Contractor and considered to be included in his bid. Shut-down of any operating facility or services including plumbing, fire protection, refrigeration, heating, air conditioning, electrical, or other installations shall be preceded by a written request at least seven calendar days prior to the shut-down.
- B. All required shut-downs unless otherwise instructed, shall be during nights, holidays, or on weekends. Any tests which are to be carried out on the building facilities and any connections to be made in the building facility which would involve a change in the system or liability to the system or involve a shut-down in light or power, the Contractor shall not proceed with such operations until he has received written permission from the Owner.
- C. Other Contractors will be performing work in the complex simultaneously while this Contractor is engaged to do work. The Contractor, in addition to coordinating with the Owner, shall coordinate and schedule shutdown of utilities, fire alarm, or equipment with the other Contractors. Should the failure of this Contractor to coordinate or notify the other Contractors of the shutdown of utilities because a monetary burden on the other Contractors, this Contractor shall compensate the other Contractor's for their reasonable monetary loss.

1.18 CONCURRENT WORK BY THE OWNER

- A. The Owner reserves the right to have other Contractors perform work in other areas of the Complex simultaneously while this Contractor is engaged to do work. This Contractor and his personnel shall cooperate and coordinate the work to be performed with all other Contractors with who he comes in contact. In no way shall this Contractor interfere with the progress of the work.

PART 2 MATERIALS AND EQUIPMENT

2.1 GENERAL

- A. All installed materials and equipment shall be new and the best of their kind and shall conform to the grade, quality and standards specified herein in every detail.
- B. Unless otherwise specifically stated, all materials and equipment offered under these specifications shall be limited to products regularly produced and recommended by the manufacturer for the service intended. This material and equipment shall have capacities and ratings sufficient to amply meet the requirements of the project. The capacities and ratings shall be in accord with Design Professional's data or other comprehensive literature made available to the public by the manufacturer and in effect at the time of opening of bids.
- C. Equipment shall be installed in accordance with manufacturer's instructions for type and quality of each piece of equipment used. These instructions shall be obtained from the manufacturer and shall be considered part of these specifications. Type, capacity and application of equipment shall be guaranteed suitable to operate satisfactorily. No experimental material or equipment shall be permitted.

- D. All multiple pieces of materials and equipment, such as, but not limited to motors, starters, vibration isolators, etc. shall be of one manufacturer.
- E. All equipment, materials and devices for which a label service is available shall bear the label of the Underwriters Laboratory, Inc. (UL).
- F. All pressure vessels shall conform to ASME Code, State Codes and Requirements and shall be constructed, inspected and stamped accordingly.

2.2 WORK DESCRIPTION

- A. In general, the work shall consist of but not necessarily be limited to the following:
 - 1. Sanitary drainage and vent systems
 - 2. Water distribution systems (domestic cold water, hot water, and hot water recirculation)
 - 3. Sterilization of domestic water system
 - 4. Valves
 - 5. Hangers and Supports
 - 6. Cleanouts
 - 7. Drains (floors)
 - 8. Traps
 - 9. Trap primers
 - 10. Backflow preventers
 - 11. Water hammer arrestors
 - 12. Plumbing specialty items
 - 13. Plumbing fixtures and accessories
 - 14. Identification
 - 15. Testing and adjusting
 - 16. Insulation

2.3 WORK INCLUDED

- A. In addition to work described above under WORK DESCRIPTION, the work shall include but not necessarily be limited to the following:
 - 1. Rigging of equipment and materials related to Plumbing Work.

2.4 CHASES AND OPENINGS

- A. Provide information to the appropriate trades regarding size and location of all openings and chases as required for the installation of this Plumbing Work.

2.5 CUTTING AND PATCHING

- A. Cutting and chasing for installation of Plumbing Work will be a part of the work of this Contract.
- B. Patching and repair of finishes will be by the General Contractor. Refer to Specification Division 09 – Finishes.

- C. Provide sleeves for pipes passing through poured concrete decks, footings, walls, etc. Cut all openings for piping passing through precast concrete or existing concrete or masonry. Such holes shall be cut with core drill or similar equipment. They shall not be cut with hammer and chisel, or with any power tool depending on impact for its cutting power.

2.6 ELECTRICAL WORK

- A. All electrical work shall be done in strict accordance with the requirements of the National Electrical Code and the Electrical Specifications. All electrically operated equipment shall bear an Underwriter's Laboratories label where labeling service is available for that type of equipment.
- B. All motor frames shall be grounded. Electric power, control and grounding connections shall be factory wired to an outlet box or terminal strip enclosure on the apparatus for easy connection by the Electrical Contractor.
- C. Motors for use on equipment with variable speed drives shall be compatible for drive usage and be constructed per NEMA Standard MG-1 Part 31. Coordinate with variable speed drive manufacturers for motor requirements and drive output characteristics. All such motors shall have their cases bonded to the driven machinery frame with a ground strap.
- D. Disconnect switches shall be furnished by the equipment manufacturer. If disconnect switches are not available from the equipment manufacturer they shall be provided by the Electrical Contractor. Coordinate with the electrical drawings and specifications.
- E. Disconnect switches shall be as specified within the equipment specifications and shall suit the environment in which installed.
 - 1. NEMA 1: Indoor application no water. Factory standard.
 - 2. NEMA 3R: Outdoor application falling rain water.
 - 3. NEMA 4: Outdoor application hose directed water.
 - 4. NEMA 4X: Same as NEMA 4, but corrosion resistant.
 - 5. NEMA 7 and 9: Explosion resistant indoor and outdoor use.
 - 6. NEMA 12: Industrial use, dust-tight and drip-tight, oil resistant for indoor use.

2.7 SUBSTITUTIONS

- A. Comply as applicable with Section 01 60 00 – Product Requirements or as indicated in each product specification.
- B. Equipment may be shown or specified in several ways:
 - 1. Manufacturer and catalogue or model number with the words "no substitutions," "no equal," "(manufacturer) only," or words of similar respect. Contractor shall furnish the specified item.
 - 2. Several manufacturers and model numbers listed; or one manufacturer and model number, followed by "equals by (mfr A), (mfr B), (mfr C)," or words of similar respect.

- a. If one of the manufacturers is listed on the drawings, that manufacturer shall be considered the basis of design. If none is so listed, the first manufacturer named in the Specification shall be considered the basis of design.
 - b. Where manufacturer's or supplier's name, style and catalog numbers are mentioned in the description of material and equipment in the specifications or on the drawings, it is to be understood that they are for the purpose of setting a standard.
 - c. If Contractor elects to furnish equipment other than the basis of design, he shall verify capacities, physical size, weight, electrical requirements, methods of connection to other parts of the system, and all other relevant data. Contractor shall be responsible for informing the Design Professional of all changes required to other equipment, spaces, structure or systems in order to install the substituted equipment. He shall furnish all required shop drawings or sketches required for Design Professional to evaluate the required changes, and shall be responsible for all costs associated with such changes, including costs of design or engineering, if such are necessary, and costs of other trades.
3. Where manufacturer's or supplier's names are listed in conjunction with the manufacturer or supplier that is basis of design, they are given to approve the firm name only. Equipment or material submitted by such firms must meet the detailed technical specifications written for the respective item. Contractor shall be responsible for verifying capacities, physical sizes, weights, electrical requirements, and methods of connection to other parts of the system, etc. Contractor shall furnish all required shop drawings for equipment, and for its connection and installation.
- C. If any substituted items are submitted after contracts have been awarded, and there is any question of equality of such items, samples may be required to be submitted both for the item specified and that to be substituted, or, further proof of equality may be required to the entire satisfaction of the Design Professional. In no case shall additional remuneration be allowed because of the rejection of a substitute.
- D. When the equipment is relocated to a place other than that shown on the drawings, or when equipment other than that specified is used, the Contractor shall pay the extra cost of required revisions such as structural steel, concrete, electrical, piping, etc.
- E. The Owners costs associated with additional Engineering and revisions to the Drawings and Specifications associated with evaluating substitutions shall be borne by the Contractor in the form of credits to appeal of the Contractors Application for Payment.

2.8 SHOP DRAWINGS

- A. Refer also to Division 00, 01 and other Division 22 sections.
- B. Furnish shop drawings, catalog cuts, performance data and other required data to the Design Professional for approval for all material and equipment specified hereinafter. Sufficient data shall be submitted to show compliance with the requirements of the plans and specifications. All shop drawings submitted shall be first checked and corrected before submitting for approval. Approval for shop drawings by the Design Professional will not relieve the Contractor from responsibility for errors or omissions therein. All such errors or omissions must be made good by the Contractor irrespective of any approval by the Design Professional.

- C. Each shop drawing submitted shall be identified by the Project Name, Specification Section, and Drawing Numbers.
- D. Each submittal shall be required to bear the review stamp of each Contractor associated with the processing of the document. The processing of shop drawings shall follow contractual relationships between the Prime Contractor and all Sub-contractors
- E. Shop drawings which require coordination of two or more trades shall be required to bear the stamp of coordinating trades. Sheetmetal, ductwork, because of its bulkiness, shall take precedence.
- F. On submissions beyond the initial one, clearly identify changes made from the initial submittal other than those requested by the Design Professional. The Design Professional will review only those changes he requested and those identified by the Contractor.
- G. Shop drawings required shall include, but not necessarily be limited to, the following:
 - 1. Shop drawings, cuts and catalogue information showing appearance, dimensions, performance, weight, etc., of all equipment, appurtenances, etc.
 - 2. Schedules of all materials showing type and manufacturer.
 - 3. Wiring diagrams and schematics for equipment.
 - 4. All special equipment and systems.
 - 5. Any special constructions.
 - 6. Other shop drawings as may be requested.
- H. Digital files of Plumbing Work will not be provided for the purpose of shop drawing preparation. Digital files of architectural plans, elevations, sections, etc. may be available for background purposes; it is the responsibility of the Contractor to confirm availability prior to bid.
- I. Facsimile submission of shop drawings will not be accepted as the submittal format. An advanced copy for starting the process may be faxed but hard copy submittals are to be submitted for actual review.
- J. Electronic submission of shop drawings shall be permitted in the format as indicated by the Architect per Division 00 and 01.
- K. Shop drawings shall be submitted in a timely manner, taking due account of time requirements for processing, correcting and distributing the shop drawings to all persons or trades requiring the information, as well as time required for manufacture of the equipment. Design Professional will not be responsible for construction delays resulting from late submission of shop drawings, nor for delays caused by the need to correct and resubmit shop drawings which were not correct, which involved substituted equipment, or otherwise required review, correction and resubmission.
- L. If Contractor elects to proceed to install equipment for which approved Shop Drawings have not been received, he does so at his own risk; Design Professional is not obligated to accept such equipment or work, nor will Design Professional be liable for claimed costs or delays required by correction of such work.

- M. Multiple pieces of materials and equipment such as valves, pumps, insulation, air devices, etc. shall be of one manufacturer.

PART 3 EXECUTION

3.1 VISIT THE SITE

- A. Before submitting bid, visit the site of the work and be thoroughly familiarized with the conditions affecting the work. No extra payment will be allowed on account of extra work made necessary by failure to do so.

3.2 WORKMANSHIP

- A. All work shall be installed in a first class, neat and workmanlike manner by mechanics skilled in the trade involved. All details of the installation shall be mechanically correct. Should the Design Professional direct removal, change, or installation of any equipments or systems not installed in a neat and workmanlike manner, such changes shall be made by the Plumbing Contractor at no expense to the Owner.
- B. Equipment shall be installed in strict accordance with manufacturer's instructions for type and capacity of each piece of equipment used. The Contractor shall obtain these instructions from the manufacturer and these instructions shall be considered part of these Specifications.
- C. Drawings are generally indicative of the work to be installed, but do not indicate all bends, offsets, fittings, valves, traps and specialties which may be required, or the exact locations of all piping and ductwork. Contractor shall investigate structure and finish conditions affecting his work and arrange his work accordingly; furnishing such items as may be required to meet such conditions. Contractor is responsible for exercising proper judgment to arrange his work and materials so as to avoid interference with other trades.
 - 1. Riser diagrams and schematics generally indicate equipment to be used in various systems involved. This information may or may not be duplicated on the plans, but equipment shown on either plans or riser diagrams and schematics shall be provided as if shown on both.
 - 2. All grades, elevations, dimensions and clearances of equipment shown on drawings are approximate and shall be verified at site.
 - 3. Where work or equipment is referred to in singular terms, such reference shall be deemed to apply to as many items of work or equipment as required to complete entire installation.
- D. All piping shall be installed so as not to interfere with any electric lighting outlet, ductwork, other piping or equipment. No piping shall pass in front of or interfere with any opening, door or window. Headroom in front of such openings and doors shall not be less than the top of the opening. Contractor shall not install piping with valves, joints or fittings over any motor, transformer, electrical switchboard or equipment.
- E. All piping and other work required by these specifications and by applicable drawings will be laid out and installed with complete work of all trades in mind. The Contractor is cautioned that close coordination between the trades will be required for the successful completion of the work, and in case interference with the work of other trades should develop, The Design Professional shall determine which work is to

be relocated, regardless of which was first installed at no additional expense to Owner.

- F. All piping and other work shall be installed so as to preserve access to all valves, traps and other parts requiring access or servicing.
- G. All piping valves and fittings shall be kept a sufficient distance from other work to permit a clearance of not less than one (1) inch between the finished covering on such ducts, piping, valves and fittings, and all adjacent work. Particular attention shall be given to this requirement in regard to piping at all major equipment.
- H. Pipes shall be cut accurately to measurements established at the job site and shall be installed without springing or forcing. Changes in direction or reduction in size shall be made with standard fittings. No mitering of pipe to form elbows or reducers will be permitted. Before erection, all piping shall be thoroughly cleaned and, if necessary, after erection to remove any foreign matter. Remove all burrs and sharp edges from piping.
- I. All water piping systems shall be installed in such manner that systems can be drained or vented completely. Provide manual air vents at high points and drain valves at low points. Piping to all fixtures and equipment shall extend from the top of the mains as indicated on drawings and all branches shall be valved in the horizontal run off at the mains. All hot water piping shall be installed with expansion loops or expansion joints as indicated on the drawings and shall pitch up in the direction of flow.
- J. For connections to existing systems, the Contractor shall drain all existing piping systems, as required, to make new connections to the systems. After the work is completed, the existing systems shall be refilled, purged of all air, and operated to assure that they function properly. Connections to existing systems shall be made using any of the following methods as applicable:
 - 1. Drain system first and then make connection.
 - 2. Wet-tap method.
 - 3. Quick freeze method.
- K. All un-insulated piping exposed in occupied areas must be provided with heavy, solid pattern, painted escutcheons where such materials pass through wall, floors, or ceilings. Escutcheons are not required in equipment rooms or unfinished areas.
- L. Installation of valves, dampers, equipment and devices shall provide full accessibility for service and maintenance.

3.3 LINES AND GRADES

- A. Layout work and establish heights and grades for work in strict accordance with the intent expressed by the drawings and all the physical conditions at the building and be responsible for the accuracy of same.

3.4 FIELD MEASUREMENTS

- A. Before ordering any material or doing any work, verify all measurements at the building and site and be responsible for the correctness of same. No extra compensation will be allowed on account of differences between actual dimensions and measurements and those indicated on the drawings. Any

difference which may be found shall be submitted to the Design Professional for consideration before proceeding any further with the work.

3.5 DELIVERY OF EQUIPMENT

- A. Be responsible for delivery of equipment, unload and store in a manner not to interfere with the operation of other trades. Additional expense incurred because of equipment or material delivery delays shall be assumed by the responsible Contractor.

3.6 PROTECTION OF WORK

- A. All work, equipment and materials shall be protected at all times.
- B. All piping openings shall be closed with caps or plugs during installation. All equipment shall be tightly covered and protected against dirt, water, plaster, paint and other foreign material or mechanical injury during entire progress of installation. Make good all damage caused either directly or indirectly by workmen employed to fulfill requirements of the Plumbing Work.

3.7 REMOVAL OF RUBBISH

- A. During the course of construction, periodically remove from the premises all rubbish resulting from work of this trade so as to prevent its accumulation. At the completion of the work contemplated under these Specifications remove from the building and site all rubbish and accumulated materials of whatever nature not caused by the other trades and leave work, and equipment free of all foreign matter including plaster, cement, and paint and leave in a clean, orderly, acceptable and usable condition.

3.8 COODINATION WITH OTHER TRADES

- A. Work in conjunction with each of the other trades to facilitate proper and intelligent execution of work with minimum interference.
- B. Carefully examine all architectural and structural drawings for the building and drawings for electrical trade and other mechanical trades and be responsible for the proper fitting of all material and equipment into the building as planned and without interference with other piping, ductwork, conduit or equipment. Proper judgment shall be exercised to secure best possible headroom, door and window clearance, and space conditions throughout; to secure neat arrangement for piping, equipment and conduit: and to overcome all local difficulties and interferences to best advantage. Approval for any and all changes to plans and specifications which may thus be incurred shall be obtained from the Design Professional before proceeding.
- C. Contractor shall prepare preliminary piping drawings suitable for use in coordinating his work with the work of other trades. The Plumbing Contractor shall prepare and furnish CAD files of drawings at 3/8" = 1'-0" scale illustrating the coordination with all trades. Drawing shall indicate equipment access requirements, piping, ductwork and conduit in relation to all structural elements of the construction, including floor elevations; steel locations, size, and elevations; partitions locations; door locations and direction of swing; and all other information required to assure coordination of the electrical, sheet metal and piping trades and fire protection in relation to the Architectural function of the project.

Coordination meetings shall be held under the supervision of the Owner's Construction Manager and General Contractor.

- D. Each trade shall have proper representation at all coordination meetings for the purpose of detailing, on a print of the coordinated drawings mentioned above. The exact location and routing of sheetmetal ductwork, because of its bulkiness, shall take precedence. After the conclusion of the coordination at the working meetings, each trade shall sign the coordinated print, copies of which shall be distributed by the GC to all contractors and parties concerned including the Owner. A print of each final coordination CAD drawing with the participants contractors "signoff" signatures appended shall be submitted to the design professional for record.
- E. If contractor installs work so as to cause interference with work of other trades, he shall make necessary changes in work to correct the condition without extra charge.
- F. Dimensional layout plans of equipment rooms shall be made showing all bases, pads and inertia blocks required for plumbing equipment. Include dimensions of bases, bolt layouts, details, etc.
- G. Contractor shall furnish all necessary templates, patterns, etc. for installing work and for purpose of making adjoining work conform, furnish setting plans and shop details to other trades as required.

3.9 COORDINATION OF CONTROL EQUIPMENT

- A. The Plumbing Contractor shall furnish all starters, push buttons for local or remote control, controllers, pressure switches, aquastats, thermostats, float switches or similar items together with all appurtenances and accessories required to operate the equipment furnished under these specifications and necessary to perform the operating functions as specified, shown on the drawings, or otherwise required.
- B. The Electrical Contractor will mount and provide power-wiring for all starters and will furnish and install all other safety switches or other line-disconnecting or protective devices. Where the starter and/or safety switch is an integral part of the equipment assembly, the assembly shall be furnished with the wiring complete between starter, controller and motor and the Electrical Contractor will make power connections only.
- C. All control wiring to automatic-operated switches, pressure switches, aquastats or other devices which actuate the starter or other items associated with the systems shall be furnished, installed and wired by the Plumbing Contractor. The Electrical Contractor will supply 120V electric power to the control panels for these special systems to the extent shown on Electrical Drawings. All other wiring (including additional power circuit if required) shall be the responsibility of the Plumbing Contractor.
- D. The Plumbing Contractor shall carefully check the current characteristics available to each location before ordering motors.
- E. If procurement requirements necessitate a change in voltage, phase, horsepower or other characteristics of any motor, the Plumbing Contractor shall obtain approval of such change from the Design Professional and shall be responsible for necessary arrangements for notifying the Electrical Contractor, and shall pay the costs, if any, required by the change, including Engineering costs.

- F. All electrical equipment furnished and installed under this contract shall be furnished with full complement of control equipment, control wiring, conduit and all other items necessary for satisfactory operation.
- G. The Electrical Contractor will complete all electrical power connections, through the disconnect and/or thermal cutouts, starter and motor terminals. He will be responsible for final power connections.
- H. The Electrical Contractor will be responsible for proper rotation of three phase equipment.
- I. All electrical work, equipment and material furnished under this Section shall be furnished and installed in accordance with Electrical Specifications – Division 26.

3.10 EXPANSION OF PIPING

- A. All piping connections shall be made so as to allow for perfect freedom of movement of piping during expansion and contraction, without springing or creating air pockets which will impair the flow of the water through the system. Install expansion loops as shown on the drawing or as required. Expansion loops shall be made with swing joints, bends or long offsets as necessary.

3.11 ANCHORS AND GUIDES

- A. Anchors and guides shall be provided where shown and/or required for the proper control of stress in piping due to expansion.
- B. Securely anchor all piping utilizing expansion loops to the building structure with steel angles, properly braced and welded to the pipe. The projects' Structural Engineer shall review all loads imposed upon the structure by the piping system. The Contractor shall be required to submit shop drawings detailing the proposed anchors for review.
- C. All piping which must be provided with expansion loops shall be fitted with pipe guides in the quantity and spacing recommended by the manufacturer. Guides shall be firmly attached to the building structure.

3.12 ACCESS

- A. All equipment requiring maintenance or adjustment must be accessible. Items located above ceilings shall be located above accessible portions of the ceiling or above access panels provided by this Contractor. Manufactured items with internal components requiring access (whether integral with the enclosure or not) shall be provided with access panels.
- B. Provide access panels in walls and ceilings to give access to all cleanouts, fire dampers, automatic and manual volume dampers, valves, temperature control equipment, junction/pull boxes, and other similar mechanical, plumbing, and electrical devices which could otherwise be inaccessible.
- C. In unplastered masonry block walls, the height of the panels shall be a multiple of the height of the block courses. All access panels shall not be smaller than 12 inches wide by 18 inches unless otherwise indicated or directed, and they shall be installed flush with the finished wall or ceiling and shall be painted with not less than two coats of paint to match adjacent surfaces.

- D. In fire rated assemblies the access panels shall be fire rated.

3.13 FIRESTOPPING

- A. All penetrations through fire-resistance-rated floor, fire resistance rated, floor/ceiling assemblies and roof construction and through fire-resistance-rated walls and partitions shall be fire stopped.
- B. Penetrations to be fire stopped include both empty openings and those containing cables, pipes, ducts, conduits and any other items.
- C. Fire rating of sealed penetrations shall meet or exceed the rating of the assembly being penetrated.
- D. Materials shall be installed in accordance with manufacturer's recommendations and their UL listing.

3.14 IDENTIFICATION OF PLUMBING EQUIPMENT AND PIPING

- A. All equipment shall have securely attached a manufacturer's nameplate giving complete data as to design and operating characteristics. Nameplates shall not be painted covered or otherwise concealed or obscured.
- B. All operating equipment, switches, starters, safety switches, panels, junction boxes, breakers, gauges, control devices and similar equipment shall be identified and shall have nameplates giving the name and number of the item of equipment. Nameplates shall be two tone printed white paper enclosed in a transparent, laminated, plastic case with permanently sealed edges. Nameplates shall be securely attached to the equipment or where this is not practicable, they shall be attached by brass link chains.
- C. All new piping throughout and all reinsulated piping shall have legends giving the nature of service, as for example "Cold Water Piping", together with arrows indicating the direction of flow. Characters shall be not less than 1½" high generally, and not less than 2" where the pipes are 10' or more above the floor. Legends and arrows shall be placed adjacent to each other and at any change of direction, and intermediately not over 30' apart. Pipe identification shall be manufactured by Wilmington Plastic Co., Brady Co. or Seton Corp. with colored paper laminated between (2) two Vinylite sheets. Coloring shall be ASME Code color. Coordinate with Section 22 05 53 – Identification for Plumbing Piping and Equipment for all tagging and identification requirements.

3.15 VALVE TAGS

- A. Each valve furnished under this section of the contract shall be identified by an approved tag attached to the valve with a brass chain. Tag shall be brass two (2) inches in diameter with the following information typed thereon: Valve number, valve size, and service of the valved line. Coordinate with Section 22 05 53 – Identification of Plumbing Piping and Equipment for all tagging and identification requirements.
- B. The Contractor shall prepare lists of all valve tags giving the number and location of each valve, valve size, service of valved line, and the equipment or portion of the system controlled. The lists shall indicate the piping services and shall be prepared with consecutive numbers for all valves within the same zone.
- C. This Contractor shall furnish two (2) sets of all valve tag lists framed under glass in a metal or hardwood frame and hung where directed. In addition, the Contractor shall furnish two (2) bound copies of all

valve tag lists prepared in directory form as approved.

3.16 TESTING AND ADJUSTING – PLUMBING

- A. All domestic cold, hot and hot water recirculation piping shall be tested and proven tight under hydrostatic pressure of not less than 1.5 times the operating pressure, but not less than 150 psig, measured at the lowest points in the systems. Tests of concealed piping shall be made before the piping is closed in. Test pressure shall be held for a period of 24 hours without any loss of pressure. Leaks in threaded fittings shall be corrected by remaking the joints. Caulking of leaks will not be permitted. Tests shall be conducted again if required by The Design Professional. The Contractor shall notify The Design Professional, or Owner's representative 24 hours prior to any hydrostatic test and test shall only be performed in the presence of and approved by Owner's representative. Tests shall be made before any non-conductive covering is applied.
- B. Test all sanitary drainage and vent piping in accordance with the Philadelphia Plumbing Code. No pipe will be covered or concealed in any manner until reviewed by authority having jurisdiction.
- C. The Contractor shall comply with all rules and regulations, local codes and the requirements of the utility companies pertaining to tests and shall perform all tests including the furnishing and installing all necessary fittings and equipment required to complete all tests.
- D. All equipment shall be adjusted so that they will perform as specified and as required to give satisfactory operation.
- E. All tests shall be made before piping is covered or concealed. Any leaks appearing shall be repaired to the satisfaction of The Design Professional.
- F. Before the systems are adjusted, tested or placed in operation, all piping and equipment shall be cleaned of all dust, dirt and other debris, so that no dirt will be carried into the system.

END OF SECTION 220500

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SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gate Valves.
 - 2. Ball Valves.
 - 3. Butterfly Valves.
 - 4. Check Valves.
- B. Related Sections:
 - 1. Section 22 05 03 -Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product and installation requirements for pipe hangers and supports.
 - 2. Section 22 07 00 - Plumbing Insulation: Product and installation requirements for insulation for valves.
 - 3. Section 22 11 00 - Facility Water Distribution: Product and installation requirements for piping, and equipment used in domestic water systems.
 - 4. Section 22 13 00 - Facility Sanitary Sewerage: Product and installation requirements for piping, piping specialties, and equipment used in sanitary waste and vent systems.
 - 5. Section 22 14 00 - Facility Storm Drainage: Product and installation requirements for piping, piping specialties, and equipment used in storm drainage systems.
 - 6. Where variations in the Design Guide and these specifications occur the more stringent specification shall be followed.
 - 7. Contractor shall perform commissioning tasks as detailed in the pre-functional and functional test sheets developed by the commissioning agent. The functional test sheets shall include line item checks which will verify the interaction of the fire alarm and fire protection systems with the HVAC equipment and controls. The commissioning agent shall witness a sample of the contractor performed pre-functional and functional testing. Contractor shall provide the commissioning agent with completed pre-functional test sheets for review and approval prior to scheduling of functional testing.

1.3 REFERENCES

- A. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 2. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 - 3. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- B. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.6 QUALITY ASSURANCE

- A. For drinking water service, provide valves complying with NSF 61.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing
- B. Installer: Company specializing in performing work of this section

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install valves underground when bedding is wet or frozen.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.

PART 2 PRODUCTS

2.1 GATE VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Milwaukee Valve Company.
 - 3. NIBCO, Inc.
 - 4. Stockham Valves & Fittings.

2.2 BALL VALVES

- A. Manufacturers:
 - 1. Milwaukee Valve Company.
 - 2. NIBCO, Inc.
 - 3. Stockham Valves and fittings
 - 4. Apollo

2.3 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Crane Valve, North America
 - 2. Milwaukee Valve Company
 - 3. NIBCO, Inc. Model
 - 4. Stockham Valves & Fittings

2.4 CHECK VALVES

- A. Horizontal Swing Check Valves:
 - 1. Manufacturers:
 - a. Crane Valve, North America
 - b. Milwaukee Valve Company
 - c. NIBCO, Inc.
 - d. Stockham Valves & Fittings

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping system is ready for valve installation.

3.2 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4 inch gate valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access where valves and fittings are not accessible.
- F. Refer to Section 22 05 29 for pipe hangers.
- G. Refer to Section 22 07 00 for insulation requirements for valves.

3.3 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings and as required by code.
- B. Install valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install gate valves on domestic water systems for shut-off service.

END OF SECTION 220523

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Sleeves.
 - 4. Mechanical sleeve seals.
 - 5. Firestopping relating to plumbing work.
 - 6. Firestopping accessories.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 - Power Piping.
 - 2. ASME B31.5 - Refrigeration Piping.
 - 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through Penetration Fire Stops.
 - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
 - 1. FM - Approval Guide, a Guide to Equipment, Materials & Services Approved By Factory Mutual Research for Property Conservation.

- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH - Certification Listings.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

- A. Firestopping Materials: to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- B. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.8 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10-inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10-inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section

- B. Installer: Company specializing in performing Work of this section

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping - DWV:

1. Conform to all required standards.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.

B. Plumbing Piping - Water:

1. Conform to all required standards.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. Lead Flashing:
 - 1. Waterproofing: 5 lb. /sq. ft sheet lead.
 - 2. Soundproofing: 1 lb. /sq. ft sheet lead.
- C. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.4 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sealant: Acrylic.

2.5 FIRESTOPPING

- A. Manufacturers
 - 1. Dow Corning Corp.
 - 2. 3M Fire Protection Products
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Do not drill or cut structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with all applicable codes and standards.
- B. Support horizontal piping as scheduled by code.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide sheet lead packing between hanger or support and piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.5 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal mop sink drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.7 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Fire Rated Surface:
 - 1. Seal openings as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- D. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.

3.8 FIELD QUALITY CONTROL

- A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.9 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 220529

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Stencils.
 - 2. Pipe markers.
 - 3. Labels.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. All domestic water piping and equipment shall be required to be labeled to comply with OSHA and ANSI/ASME A13.1-2007 standards for the identification of systems.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years [documented] experience.
- B. Installer: Company specializing in performing Work of this section

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.2 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
 - 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with manufacturer's recommendations.
- B. Install identifying devices after completion of coverings and painting.

- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Install piping identification on medical gas systems. Refer to Section 22 60 13.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- J. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 220553

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SECTION 220700 - PLUMBING INSULATION

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SECTION 220700 - PLUMBING INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Plumbing piping insulation, jackets and accessories.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
 - 5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - 6. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - 7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 - 10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - 13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
17. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
18. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
19. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
20. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

1.4 SUBMITTALS

- A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers for Glass Fiber and Mineral Fiber Insulation Products:
 - 1. CertainTeed.
 - 2. Knauf.
 - 3. Johns Manville.
 - 4. Owens-Corning.
- B. Manufacturers for Closed Cell Elastomeric Insulation Products:
 - 1. Aeroflex. Aerocell.
 - 2. Armacell, LLC. Armaflex.
 - 3. Nomaco. K-flex.

2.2 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation. Conform to ASTM C795 for application on Austenitic stainless steel.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.
 - 3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil Kraft with self-sealing adhesive joints.
 - 4. Jacket Temperature Limit: minus 20 to 150 degrees F.

2.3 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- C. Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement: ASTM C449/C449M.
- D. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- E. Adhesives: Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping and equipment has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Hot Piping Systems less than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- D. Inserts and Shields:
 - 1. Piping 1-1/2 inches Diameter and Smaller: Install steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 - 3. Piping Supported by Roller Type Pipe Hangers: Install steel shield between roller and inserts.

END OF SECTION 220700

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SUMMARY SECTION 221100 - FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Domestic water piping, above grade.
 - 2. Unions and flanges.
 - 3. Valves.
 - 4. Pipe hangers and supports.
- B. Related Sections:
 - 1. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
 - 2. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports [and firestopping] for placement by this section.
 - 3. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification and valve tags for placement by this section.
 - 4. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z21.22 - Relief Valves for Hot Water Supply Systems.
- B. American Society of Mechanical Engineers:
 - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 4. ASME B31.9 - Building Services Piping.
 - 5. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
 - 6. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
 - 7. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

- C. American Society of Sanitary Engineering:
 - 1. ASSE 1010 - Performance Requirements for Water Hammer Arresters.
 - 2. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers.
 - 3. ASSE 1012 - Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
 - 4. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
 - 5. ASSE 1019 - Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
 - 6. ASSE 5013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).
 - 7. ASSE 5015 - Performance Requirements for Testing Double Check Backflow Prevention Assemblies (DC) and Double Check Fire Protection Backflow Prevention Assemblies (RPDF).

- D. ASTM International:
 - 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - 4. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 5. ASTM B32 - Standard Specification for Solder Metal.
 - 6. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 - 7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 8. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 9. ASTM D 3311 - Standard Specification for Drain, Waste, and Vent (Dwv) Plastic Fittings Patterns.
 - 10. ASTM E1 - Standard Specification for ASTM Thermometers.
 - 11. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
 - 12. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 13. Astm F 891 - Standard Specification for Coextruded Poly(Vinyl Chloride) (Pvc) Plastic Pipe With a Cellular Core.
 - 14. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.
 - 15. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe.
 - 16. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

- E. American Welding Society:
 - 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

- F. American Water Works Association:
 - 1. AWWA C651 - Disinfecting Water Mains.

- G. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

3. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 4. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 5. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 6. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 7. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 8. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 9. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- H. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. Plumbing and Drainage Institute:
1. PDI WH201 - Water Hammer Arrester Standard.
- J. Underwriters Laboratories Inc.:
1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
 2. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.4 SUBMITTALS

- A. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 4. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- B. Manufacturer's Installation Instructions: Submit installation instructions for valves and accessories.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and equipment.
- B. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.6 QUALITY ASSURANCE

- A. For drinking water service, provide valves complying with NSF 61.
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: ASTM B32, Alloy Grade Sb5 tin-antimony, or Alloy Grade Sn95 tin-silver, lead free solder

2.2 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with [soldered] [brazed joints].
 - 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.3 BALL VALVES

- A. Manufacturers:
 - 1. Apollo Valves
 - 2. Milwaukee Valve Company
 - 3. NIBCO, Inc.
 - 4. Stockham Valves & Fittings
- B. Valves up to and including Two and One-half (2-1/2) inches: full port, 3-piece, bronze body ball valves with a stainless steel ball and Teflon seat conforming to ASTM B-61 or B-62.

2.4 CHECK VALVES

- A. Horizontal Swing Check Valves:
 - 1. Manufacturers:
 - a. Apollo Valves
 - b. Milwaukee Valve Company
 - c. NIBCO, Inc.
 - d. Stockham Valves & Fittings
- B. Check valves shall be swing type bronze body up to and including Two and One-half (2-1/2) inches.

2.5 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Creative Systems Inc.
 - 3. Flex-Weld, Inc.
 - 4. Glope Pipe Hanger Products Inc.
 - 5. Michigan Hanger Co.
 - 6. Superior Valve Co.
- B. Plumbing Piping: Conform to ASME B31.9
- C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- D. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
- E. Hangers for Hot Pipe, Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
- F. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

- G. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
- H. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
- I. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamps.
- J. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast-iron pipe roll.
- K. Vertical Support: Steel riser clamp.
- L. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- M. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- N. Copper Pipe Support: Carbon steel ring, adjustable, copper plate.

2.6 WATER HAMMER ARRESTORS

- A. ASSE 1010; copper construction, piston type sized in accordance with PDI WH-201.
- B. Pre-charged suitable for operation in temperature range 34 to 250 degrees F and maximum 150 psi working pressure.

2.7 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Nibco
 - 2. Cameron
 - 3. Crane
- B. 2-1/2 inches and Larger: MSS SP 67, Class 150.
 - 1. Body: Cast or ductile iron, wafer ends, stainless steel stem, extended neck.
 - 2. Disc: Nickel-plated ductile iron
 - 3. Seat: Resilient replaceable EPDM.
 - 4. Handle and Operator: 10 position lever handle.

2.8 PRESSURE GAUGES

- A. Gauge: ASME B40.1, UL 393 with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Steel.
 - 2. Bourdon Tube: Brass.
 - 3. Dial Size: 2 inch.
 - 4. Mid-Scale Accuracy: One percent.

- 5. Scale: Both psi and kPa.

2.9 WATER PRESSURE REDUCING VALVES

- A. 2 inches and Smaller: MSS SP 80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded ends.
- B. 2 inches and Larger: MSS SP 85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.
- C. Valve shall be equal to Watts Series 25AUB-Z3-HP. Set valve at 80PSI.

2.10 RELIEF VALVES

- A. Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.11 STRAINERS

- A. 2 inch and Smaller: Threaded brass body for 175 psi stainless steel perforated screen.
- B. 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.
- C. 5 inch and Larger: Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.12 HOSE BIBS

- A. Manufacturers:
 - 1. Nibco
 - 2. Apollo
- B. Interior: Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with lock shield and removable key, integral vacuum breaker in conformance with ASSE 1011.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.

- B. Remove scale and dirt, on inside and outside, before assembly.

3.2 INSTALLATION - THERMOMETERS AND GAUGES

- A. Install one pressure gauge for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gauge.
- B. Install gauge taps in piping.
- C. Install pressure gauges with pulsation dampers. Provide ball valve to isolate each gauge.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Inserts:
 - 1. Provide inserts for placement in concrete forms.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- B. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as schedule.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 - 8. Provide sheet lead packing between hanger or support and piping.
- C. Install hangers and supports in accordance with Section 22 05 29.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange systems to drain at low points.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.
- G. Provide access where valves and fittings are not accessible.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Provide support for utility meters in accordance with requirements of utility companies.
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- K. Install domestic water piping in accordance with ASME B31.9.
- L. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
- M. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- R. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- S. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- T. Test backflow preventers in accordance with ASSE 5015.

- U. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to water closets.

3.5 FIELD QUALITY CONTROL

- A. Field inspecting, testing, adjusting, and balancing.
- B. Test domestic water piping system in accordance with applicable code and local authority having jurisdiction.

3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Disinfect water distribution system in accordance with local requirements.
- C. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
- E. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 2 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION 211100

INDEX

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SECTION 221123 - FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Natural gas piping above grade.
 - 2. Unions and flanges.
 - 3. Valves.
 - 4. Pipe hangers and supports.
 - 5. Strainers.
- B. Related Sections:
 - 1. Section 05 12 00 - Structural Steel Framing: Product requirements for touch-up painting of structural steel.
 - 2. Section 05 21 00 - Steel Joist Framing: Product requirements for touch-up painting of steel joists.
 - 3. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
 - 4. Section 08 31 13 - Access Doors and Frames: Access doors for concealed valves and accessories.
 - 5. Section 09 90 00 - Painting and Coating: Product requirements for painting for placement by this section.
 - 6. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Piping materials for gas piping systems.
 - 7. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Valves for gas piping systems.
 - 8. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
 - 9. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

- B. American Society of Mechanical Engineers:
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 3. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
 - 4. ASME B31.9 - Building Services Piping.
 - 5. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- C. ASTM International:
 - 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 3. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
 - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- D. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- E. American Water Works Association:
 - 1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 67 - Butterfly Valves.
 - 3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 5. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - 6. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- G. National Fire Protection Association:
 - 1. NFPA 54 - National Fuel Gas Code.
- H. Underwriters Laboratories Inc.:
 - 1. UL 842 - Valves for Flammable Fluids.

1.4 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.9.

- D. Use plug and ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves, piping system, and system components.
- C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions.

1.7 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54.
- B. Perform work in accordance with applicable code and local gas company requirements.
- C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- D. Perform Work in accordance with applicable] code for welding hanger and support attachments to building structure.
- E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.
- F. Perform Work in accordance with State and Municipality standards.
- G. Maintain one copy each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.13 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

1.14 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.15 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
 - 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.
- B. Copper Tubing: ASTM B88, Type L.
 - 1. Fittings: ASME B16.26 cast bronze, compression type.
 - 2. Joints: Flared.
- C. Corrugated Stainless Steel Tubing: ANSI LC 1.

2.2 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with [soldered] [brazed joints].
 - 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.3 BALL VALVES

- A. Manufacturers
 - 1. Nibco
 - 2. Apollo
 - 3. Crane
- B. 1/4 inch to 1 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.
- C. 1-1/4 inch to 3 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port.

2.4 PLUG VALVES

- A. Manufacturers
 - 1. Flowserve
 - 2. Emerson
 - 3. Cameron

- B. 2 inches and Smaller: MSS SP 78, Class 150 construction, round port, full pipe area, and pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
- C. 2-1/2 inches and Larger: MSS SP 78, Class 150 construction, round port, full pipe area, and pressure lubricated, teflon packing, flanged ends. Furnish wrench-operated.

2.5 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 54.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe 3 inches and Smaller: Cast iron hook.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION - INSERTS

- A. Provide inserts for placement in concrete forms.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.9.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
- G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
- H. Prime coat exposed steel hangers and supports in accordance with Section 09 90 00. Finish paint exposed steel hangers and supports in accordance with Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Where required, bend pipe with pipe bending tools in accordance with procedures intended for that purpose.
- E. Install piping to conserve building space and not interfere with use of space.
- F. Size and install gas piping to provide sufficient gas to supply maximum appliance demand at pressure higher than appliance minimum inlet pressure.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

- I. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- J. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 22 05 29.
- K. Provide clearance for installation of insulation and access to valves and fittings.
- L. Provide access where valves and fittings are not exposed.
- M. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.
- N. Provide support for utility meters in accordance with requirements of utility company.
- O. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood. Protect vent against entry of insects and foreign material.
 - 1. Minimum Vent Size: Connection size at regulator vent connection.
 - 2. Run individual vent line from each relief device, independent of breather vents.
- P. Breather vents may be manifolded together with piping sized for combined appliance vent requirements.
- Q. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 90 00.
- R. Install identification on piping systems including underground piping. Refer to Section 23 05 53.
- S. Install valves with stems upright or horizontal, not inverted.
- T. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Where gas appliance will be damaged by test pressure, disconnect appliance and cap piping during pressure test. Reconnect appliance after pressure test and leak test connection.
- C. Where gas appliance is designed for operating pressures equal to or greater than piping test pressure, provide gas valve to isolate appliance or equipment from gas test pressure.
- D. Pressure test natural gas piping in accordance with NFPA 54.
- E. Where new branch piping is extended from existing system, pressure test new branch piping only. Leak test joint between new and existing piping with noncorrosive leak detection fluid or other approved method.
- F. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

- G. Immediately after gas is applied to a new system, or a system has been restored after gas service interruption, check pipe for leakage.
 - 1. Where leakage is detected, shut off gas supply until necessary repairs are complete.
- H. Do not place appliances in service until leak testing and repairs are complete.

END OF SECTION 221123

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SECTION 221300 - FACILITY SANITARY SEWERAGE

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SECTION 221300 - FACILITY SANITARY SEWERAGE

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sanitary sewer piping above grade.
 - 2. Pipe hangers and supports.
 - 3. Cleanouts.
- B. Related Sections:
 - 1. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
 - 2. Section 22 05 23 - General-Duty Valves for Plumbing Piping: Product requirements for valves for placement by this section.
 - 3. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
 - 4. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
 - 5. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 3. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
 - 4. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
 - 5. ASME B31.9 - Building Services Piping.
- B. ASTM International:
 - 1. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
 - 2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.

4. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 5. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 6. ASTM A536 - Standard Specification for Ductile Iron Castings.
 7. ASTM B32 - Standard Specification for Solder Metal.
 8. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
 9. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 10. ASTM B75 - Standard Specification for Seamless Copper Tube.
 11. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 12. ASTM B251 - Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 13. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
 14. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 15. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
- C. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary Drain, Waste, and Vent Piping Applications.
 2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and materials.
- C. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 4. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of equipment and clean-outs.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section
- B. Installer: Company specializing in performing Work of this section

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: ASTM C564, rubber gasket joint devices or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hub-less, service weight.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. Copper Tube: ASTM B306, DWV Type L.
 - 1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, Alloy Grade Sn95 tin-silver, lead free solder
- D. Copper Pipe: ASTM B42 Temper H80 hard drawn.
 - 1. Fittings: ASME B16.23, cast bronze, or ASME B16.29 wrought copper.
 - 2. Joints: ASTM B32, Alloy Grade Sn95 tin-silver, lead free solder.

2.2 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Copper Piping: Class 150, bronze unions with soldered.
 - 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Copper Piping: Class 150, slip-on bronze flanges.
 - 2. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.3 PIPE HANGERS AND SUPPORTS

- A. Drain, Waste, and Vent: Conform to ASME B31.9.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
- F. Wall Support for Pipe Sizes 3 inches and Larger: Welded steel bracket and wrought steel clamp.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- I. Copper Pipe Support: Carbon-steel, copper-plated adjustable ring.

2.4 CLEANOUTS

- A. Interior Finished Floor Area: Galvanized cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.
- B. Interior Finished Wall Area: Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw.
- C. Interior Unfinished Accessible Area: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Inserts:
 - 1. Provide inserts for placement in concrete forms.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- B. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
 - 7. Provide sheet lead packing between hanger or support and piping.
 - 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- E. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- F. Install piping to maintain headroom. Do not spread piping, conserve space.

- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.
- J. Provide access where valves and fittings are not accessible.
- K. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- N. Sleeve pipes passing through partitions, walls and floors.
- O. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 22 05 29.
- P. Support cast iron drainage piping at every joint.

3.5 FIELD QUALITY CONTROL

- A. Test sanitary waste and vent piping system in accordance with applicable code and local authority having jurisdiction.

END OF SECTION 221300

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SECTION 221400 - FACILITY STORM DRAINAGE

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Storm water piping above grade.
 - 2. Unions and flanges.
 - 3. Pipe hangers and supports.
 - 4. Cleanouts.
- B. Related Sections:
 - 1. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
 - 2. Section 08 31 13 - Access Doors and Frames: Product requirements for access doors for placement by this section.
 - 3. Section 09 90 00 - Painting and Coating: Execution requirements for painting material specified by this section.
 - 4. Section 22 05 03 - Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
 - 5. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment: Product requirements for motors for placement by this section.
 - 6. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping: Execution requirements for pipe expansion devices for placement by this section.
 - 7. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
 - 8. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
 - 9. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).

2. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 2. ASTM B32 - Standard Specification for Solder Metal.
 3. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
 4. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 5. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sump-pumps, catch basins and manholes.
- C. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 2. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 3. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of equipment and clean-outs.
- C. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views for pumps and equipment.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74 service weight, plain ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: ASTM C564, neoprene gasket system or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

2.2 PIPE HANGERS AND SUPPORTS

- A. Drain, Waste, and Vent: Conform to MSS SP 69.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

- E. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
- F. Wall Support for Pipe Sizes 3 inches and Larger: Welded steel bracket and wrought steel clamp.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- I. Copper Pipe Support: Carbon-steel, copper-plated adjustable ring.

2.3 CLEANOUTS

- A. Interior Unfinished Accessible Area: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9 and MSS SP 89.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 7. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

3.4 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.
- B. Install floor cleanouts at elevation to accommodate finished floor.
- C. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- D. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- E. Install piping to maintain headroom. Group piping to conserve space.
- F. Group piping whenever practical at common elevations.
- G. Support cast iron drainage piping at every joint.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.
- J. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- M. Install bell and spigot pipe with bell end upstream.
- N. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
- O. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 22 05 29.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Test storm drainage piping system in accordance with applicable code.

END OF SECTION 221400

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SECTION 224000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Lavatories.
 - 3. Electric water coolers.
- B. Related Sections:
 - 1. Section 22 11 00 - Facility Water Distribution: Supply connections to plumbing fixtures.
 - 2. Section 22 13 00 - Facility Sanitary Sewerage: Waste connections to plumbing fixtures.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- B. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
- C. American Society of Mechanical Engineers:
 - 1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
 - 2. ASME A112.18.1 - Plumbing Fixture Fittings.
 - 3. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
 - 4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
 - 5. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
 - 6. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.

1.4 SUBMITTALS

- A. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Manufacturer's Installation Instructions: Submit installation methods and procedures.

C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.6 QUALITY ASSURANCE

A. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., as suitable for purpose specified and indicated.

B. Provide plumbing fixture fittings in accordance with ASME A112.18.1 that prevent backflow from fixture into water distribution system.

C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section

B. Installer: Company specializing in performing Work of this section

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.9 WARRANTY

A. Furnish five-year manufacturer warranty for plumbing fixtures.

PART 2 PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

A. Manufacturers:

1. Refer to fixture schedule on design drawings for quality of fixture to be installed.

2.2 LAVATORIES

A. Manufacturers:

1. Refer to fixture schedule on design drawings for quality of fixture to be installed.

2.3 ELECTRIC WATER COOLERS

- A. Manufacturers:
 - 1. Refer to fixture schedule on design drawings for quality of fixture to be installed.

2.4 LAVATORY INSULATION KIT

- A. Manufacturers:
 - 1. Tru-Bro or approved equal.
- B. Product Description: Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 00, color to match fixture.
- F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

G. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit use of fixtures before final acceptance.

END OF SECTION 224000

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SECTION 23 05 00 – COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 REFERENCES

Not Used.

1.3 INSTRUCTIONS AND GENERAL REQUIREMENTS

- A. These specifications and accompanying drawings are intended to cover the furnishing of all labor, material, and equipment and superintendence of the HVAC system of the indicated project.
- B. The word "Owner" shall mean West Point Association of Graduates (WPAOG) of the USMA or their representative on this Project.
- C. The word "Contractor" shall mean the Contractors responsible for the Mechanical, Plumbing, Fire Protection and Electrical Work and who shall perform the work as described herein and indicated on the drawing with respect to the trade.
- D. The word "Design Professional" or "The Design Professional" shall mean the Architect and/or Engineer.
- E. The term "Furnish" shall mean to obtain and supply to the job site. The term "Install" shall generally mean to fix in position and connect for use. Where language indicates that one party or trade is to "install" and another is to "connect", the term "install" shall mean only to fix in position, and "connect" shall mean to make final connections to. The term "Provide" shall mean to furnish and install.
- F. It is the intent and purpose of these specifications and accompanying drawings to cover and include each item, all materials, machinery, apparatus, and labor necessary to properly install, equip, adjust, and put into perfect operation the respective portions of the installations specified and to so interconnect the various items or sections of the work as to form a complete and properly operating whole.
- G. Any equipment, apparatus, machinery, material and small items not mentioned in detail, and labor not hereinafter specifically mentioned, which may be found necessary to complete or perfect any portion of installation in a substantial manner, and in compliance with the requirements stated, implied or intended in these specifications shall be furnished without extra cost. This shall include all materials, devices or methods peculiar to the machinery, equipment, apparatus, or systems furnished and installed as part of the HVAC work.

- H. Drawings and specifications have been prepared with best knowledge of conditions available at the time of design. If any obscurities or discrepancies exist, they shall be brought to the attention of the Design Professional before bids are submitted. If they are not discovered before bids are submitted, the Design Professional shall be notified and shall render decision. This decision shall be final.
1. Drawings and Specifications are intended to be complementary; items described or shown in one but not both are to be provided as if fully shown or described in both locations.
- I. The Contractor shall carefully examine all drawings, specifications and contract documents, and the site before submitting his proposal for this work. The Contractor shall compare the site with drawings, specifications and contract documents for all other branches of the work. He shall include in his proposal any monetary sums which he may deem necessary to cover the difficulties and/or costs for furnishing and installing complete all of the work shown on the drawings, the specifications and/or implied therein.
- J. It is the intent of the Contract Documents to describe a functionally complete Project to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.
- K. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated in the Contract Documents.
- L. Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to The Design Professional any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from The Design Professional before proceeding with any Work affected thereby.
- M. If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to The Design Professional in writing.
- N. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and The Design Professional, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of The Design Professionals, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible, or by Owner.
- O. The Design Professional will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to The Design Professional in writing within 30 days of the event giving rise to the question

- P. The Design Professional will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- Q. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish The Design Professional the required certificates of inspection or approval.
- R. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and The Design Professional's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and The Design Professional.

1.4 NOISE AND VIBRATION CONTROL

- A. Noise control shall be provided to maximize the usefulness of the facility by maintaining reverberation times and background sound levels within ranges that are appropriate for the intended use of the facility.
- B. Noise control shall be in compliance with OSHA requirements for the health and safety of building occupants; control shall be for all areas of the facility.
- C. ANSI Standards shall be used as the basis for defining goals for appropriate reverberation times and acoustical isolation of various types of spaces.
- D. The latest edition of the ASHRAE HVAC Applications Handbook shall be used as the basis for defining appropriate HVAC-related background sound pressure levels for various types of spaces.
- E. The following ranges of limits shall be used as the basis:

Room or Space Type	RC(N) Range
Glee Club and Concert Band Rooms	15
Spirit Band Room and Glee Club Sectional Room	30
Workrooms, Storage Rooms, Lockers & Toilets	40 to 45

- F. Control of mechanical and electrical equipment shall be enhanced by giving attention to the proximity of the noise and vibration generating equipment to areas requiring low sound levels.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall, before submitting his proposal, visit the site of the work and acquaint himself with all conditions relevant to the work and its surroundings. The Contractor shall carefully investigate to determine any variances between actual conditions at site as shown or represented in the specifications or drawings. Anything in the contract documents or any representations, statements, or information made or furnished by The Design Professional notwithstanding, the Contractor shall, regardless of any such conditions relevant to the work, the site of work or its surroundings, assume full and complete

responsibility thereof, and all risk in connection therewith at no additional cost to the Owner.

- B. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- C. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and The Design Professional except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.
- D. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.
- E. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by The Design Professional, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- F. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

1.6 CODES, RULES, PERMITS, FEES, AND STANDARDS

- A. All work described in this specification shall be done in accordance with any applicable Federal, State and Local Codes, Laws, Ordinances, Rules and Regulations governing work of this type.
- B. The Contractor shall give all necessary notices, obtain all permits and pay all governmental taxes, fees, deposits and other costs in connection with his work. He shall file all necessary plans, prepare all documents and obtain all required Certificates of Inspection and Approval for his work, including those for occupancy, and deliver same to The Design Professional before request for acceptance and final payment for the work.
- C. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, drawings, in addition to Contract Drawings and Documents in order to comply with all applicable Codes, Laws, Ordinances, Rules and Regulations, whether or not shown on Drawings and/or Specifications.
- D. Nothing stated or shown in the Contract Specifications and Drawings is intended to conflict with the above regulations. Should the Contractor find any apparent conflict, it shall be his responsibility to notify the Design Professional before any work in question is performed or materials purchased.
- E. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or

Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of The Design Professionals, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work.

- F. All materials furnished and all work installed shall comply with the following rules, codes, and standards:

New York State Building Codes including:

2020 Building Code of New York State: IBC 2018 w/Amendments

2020 Existing Building Code of NYS: IEBC 2018 w/Amendments

2020 Mechanical Code of NYS: IMC 2018 w/Amendments

2020 Energy Conservation Code of NYS: IECC 2018 w/Amendments

Other Rules, Codes, & Standards

ASHRAE Std. 90.1-2016

ASHRAE Std. 62.1-2013

ASHRAE Std. 15-2016

ASHRAE Std. 55-2013

ASHRAE Handbooks

ASME B31.8 Gas Transmission and Distribution Piping System

Army & United Facility Criteria (UFC) including:

UFC 3-410-01 Design: Heating, Ventilating, & Air Conditioning Systems

UFC 3-410-02 Lonworks Direct Digital Control for HVAC & Other Local Building Systems

UFC 3-420-01 Plumbing Systems

UFC 3-450-01 Noise & Vibration Control

UFC 3-470-01 Lonworks Utility Monitoring & Control Systems (UMSC)

NFPA 54 National Fuel Gas Code

NFPA 90A Air Conditioning and Ventilating Systems

SMACNA

UL Underwriter's Laboratories

ANSI

ASME

ASTM

AMCA

ARI

NFPA 70 National Electric Code

ACRMA Equipment Standards

Recommendations of the Fire Insurance Organization having jurisdiction

- G. All package equipment shall be independently third party labeled as a system for its intended use by a nationally recognized testing laboratory in accordance with OSHA 29CFR 1910, NEC, and NFPA.

1.7 ABBREVIATIONS

- A. The following is a description of the abbreviations used herein:

AC	Alternating Current
ACRMA	Air conditioning & Refrigerating Machinery Assoc., Inc.
AIEE	American Institute of Electrical Engineers
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating & Air Conditioning Engineers
ASA	American Standards Association
ASTM	American Society of Testing Materials

AWG	American Wire Gauge Size
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NFC	National Fire Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Association
U.L.	Underwriters' Laboratories, Inc.
IBC	International Building Code
IMC	International Mechanical Code

- B. Refer to the drawings for other symbols and abbreviations.

1.8 WORKMANSHIP

- A. All work under this Contract shall be properly coordinated with the work of all trades and separate Contractors with which it comes in contact.
- B. All work under this Contract shall be installed in a first-class, neat and workmanlike manner satisfactory to The Design Professional by experienced and skilled mechanics of the trade involved.
- C. All material and equipment shall be new and shall conform to the grade, quality, and standards specified herein in every detail.
- D. All materials and equipment shall be made in the USA.
- E. All equipment offered under these specifications shall be limited to products regularly produced and recommended for the specified service. Ratings shall be in accordance with the Design Professional's data or other comprehensive literature made available to the public and in effect at this time.
- F. Equipment shall be installed in strict accordance with the manufacturer's instructions for type and capacity of each piece of equipment used. Contractor shall obtain these instructions and they shall be considered a part of these specifications. Type, capacity, and applications of equipment shall be suitable and shall operate satisfactorily for the purpose intended in the system.
- G. All equipment, materials, and devices for which label service is available, shall bear the label of the Underwriters Laboratories, Inc.

1.9 OPERATING INSTRUCTIONS

- A. Provide to the Owner three bound copies of complete written instruction on the operation, care and maintenance of each piece of equipment and the installation as a whole. Include frequency of inspection, cleaning and adjusting and other attention as may be required in accordance with manufacturer's instructions. Material shall be manufacturer's brochures, catalog cuts, parts lists, wiring diagrams, etc. Also supply Owner's with three complete sets of approved shop drawings.
- B. The instructions shall be prepared by section, labeled and include detailed parts list data and the name, address and phone number of the nearest supply source.

- C. The manuals must provide all the information required to run the building efficiently. Provide description of all the equipment operation. The materials submitted must include installation manuals, repair manuals, programming manuals, troubleshooting manuals, and parts manuals.
- D. The manufacturer's specifications sheets, if generalized in any way, will be clearly marked to show exactly which item has been supplied, and the job designation for that item (e.g. PRV-1) will be noted on manufacturer's specification sheet which includes all details for this unit including the complete model number, motor hp, voltage, etc.
- E. If there are differences between pieces of equipment, then include a specification sheet for each, properly marked.
- F. Include temperature control diagrams, written sequence of operation, control program files and service instructions including any specialized tools required to perform service.
- G. Provide one section for preventive maintenance procedures.
- H. Provide lubrication diagrams and procedures.
- I. Include Contractor's phone numbers and any other reference required to obtain warranty service.
- J. Furnish qualified personnel to instruct the Owner's personnel in the maintenance and operation of all equipment and systems. Instructing personnel shall remain on the job continuously during working hours until such instruction is complete, but not less than 16 hours.
- K. A video recording in digital format (DVD) of the operator training session shall be made during this training period and the DVD submitted to the Owner with the operation and maintenance manuals.

1.10 CORRECTION OF WORK AFTER FINAL PAYMENT AND GUARANTEE

- A. Comply as applicable with Section 01 20 00 – Price and Payment Procedures.
- B. Final payment shall not relieve the Contractor of responsibility for faulty equipment, materials and workmanship and unless otherwise specified he shall remedy any defects due thereto and pay for damage to other work resulting therefore, which shall appear within a period of one (1) year from the date of acceptance.
- C. Include guarantees by the respective equipment manufacturers which shall be subject to the terms and time limits defined under this section.
- D. Guarantees furnished by Subcontractor and/or equipment manufacturers shall be counter-signed by the related Prime Contractor for joint and/or individual responsibility for subject item.
- E. Manufacturer's equipment guarantees or warranties extending beyond the guarantee period described herein shall be transferred to the Owner along with the Contractor's guarantees.

1.11 SUPERINTENDANCE

- A. The Contractor shall give his personal superintendence to the work or shall have a competent superintendent, satisfactory to The Design Professional, and the Owner, present at all times during construction with authority to act for him. The Contractor shall also provide an adequate staff for the

proper installation, coordination and expediting of his work.

1.12 SCAFFOLDING, RIGGING, HOISTING

- A. The Contractor shall furnish all scaffolding, staging, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished or installed by him and shall remove same from premises when no longer required.
- B. Scaffolding and staging construction and maintenance shall be in strict accordance with all applicable codes and regulations including Contractor's safety regulations. The structure shall be erected so as not to interfere with the work of others. If it becomes necessary to move the scaffolding and/or staging to permit installation of other work, the Contractor shall do so at his own expense.
- C. Scaffolding, staging and hoisting equipment shall not be supported from piping, conduits or other equipment.
- D. Each Contractor will be responsible for providing all materials, equipment supports, supplies and labor necessary to support and brace and strengthen equipment according to industry trade standards and approved materials provided under his contract.

1.13 ROOF PROTECTION

- A. Provide adequate roof protection during the construction phase and remove same after the work is completed. Any damage to the roof surface will be repaired at the expense of the Contractor.

1.14 SUPPORT STEEL AND MISCELLANEOUS STEEL WORK

- A. The Contractor shall provide all necessary miscellaneous steel required for the installation and support of the work under this contract. Work shall include but not be limited to piping supports, equipment supports, gratings, handrails, transformers, etc. Perform all rigging required to set the equipment in place.
- B. Unless otherwise indicated, all structural steel shall be ASTM-A36 with hot dipped galvanized finish. Welds shall be finished with (2) coats of zinc rich paint.

1.15 AS-BUILT DRAWINGS

- A. The Contractor shall keep on the job a separate set of drawings on which he shall make a record of any changes in location, size or other details or installation not covered by supplemental or detail drawings. Such records shall be made at the time the changes in the work are made so that at any time the marked drawings indicate the true condition of the work. He shall record the exact dimensioned locations, grades, elevations and sizes of all underground and under floor slab conduit and piping. Dimensions shall be distance from columns, finished building surfaces, curbs and finished grade lines. At the completion of the work the marked drawings shall be transferred to AutoCAD 2011 (or later) drawings and the drawing files shall be forwarded to The Design Professional.

1.16 GUARANTEE

- A. All equipment and components of all systems furnished under this Contract shall be guaranteed to perform trouble free for a period of one year from the date of final acceptance of installation by The Design Professional. Any equipment that has been in operation prior to the date of acceptance shall

also be guaranteed to be free of defects and perform without failures for a period of one year after the date of final acceptance. Any corrections and adjustments to the systems, replacement of equipment or parts during the guarantee period shall be furnished by the Contractor, at no additional cost to Owner.

- B. During the one (1) year guaranty period the Contractor shall make a minimum of two (2) visits to the site (6 months after acceptance and immediately prior to the end of the guarantee period). During each visit, the Contractor shall thoroughly check all equipment for proper operation. Reports shall be generated and forwarded to the Owner describing the systems inspected, date of inspection, and status of equipment.
- C. See Paragraph 3.6 for early use of HVAC equipment.

1.17 SCHEDULING OF WORK

- A. The scheduling of any work affecting existing installations or facilities, shall be coordinated with the Owners' representative. Shut-down of utilities or equipment affecting operations of any existing part of the building will not be permitted except as provided below. Any premium time or additional cost to comply shall be at the expense of the Contractor and considered to be included in his bid. Shut-down of any operating facility or services including plumbing, fire protection, refrigeration, heating, air conditioning, electrical, or other installations shall be preceded by a written request at least seven calendar days prior to the shut-down.
- B. All required shut-downs unless otherwise instructed, shall be during nights, holidays, or on weekends. Any tests which are to be carried out on the building facilities and any connections to be made in the building facility which would involve a change in the system or liability to the system or involve a shut-down in light or power, the Contractor shall not proceed with such operations until he has received written permission from the Owner.
- C. Other Contractors will be performing work in the complex simultaneously while this Contractor is engaged to do work. The Contractor, in addition to coordinating with the Owner, shall coordinate and schedule shutdown of utilities, fire alarm, or equipment with the other Contractors. Should the failure of this Contractor to coordinate or notify the other Contractors of the shutdown of utilities because a monetary burden on the other Contractors, this Contractor shall compensate the other Contractor's for their reasonable monetary loss.

1.18 CONCURRENT WORK BY THE OWNER

- A. The Owner reserves the right to have other Contractors perform work in other areas of the Complex simultaneously while this Contractor is engaged to do work. This Contractor and his personnel shall cooperate and coordinate the work to be performed with all other Contractors with who he comes in contact. In no way shall this Contractor interfere with the progress of the work.

PART 2 MATERIALS AND EQUIPMENT

2.1 GENERAL

- A. All installed materials and equipment shall be new and the best of their kind and shall conform to the grade, quality and standards specified herein in every detail.
- B. Unless otherwise specifically stated, all materials and equipment offered under these specifications shall be limited to products regularly produced and recommended by the manufacturer for the service intended. This material and equipment shall have capacities and ratings sufficient to amply meet the requirements of the project. The capacities and ratings shall be in accord with Design Professional's data or other comprehensive literature made available to the public by the manufacturer and in effect at the time of opening of bids.
- C. Equipment shall be installed in accordance with manufacturer's instructions for type and quality of each piece of equipment used. These instructions shall be obtained from the manufacturer and shall be considered part of these specifications. Type, capacity and application of equipment shall be guaranteed suitable to operate satisfactorily. No experimental material or equipment shall be permitted.
- D. All multiple pieces of materials and equipment, such as, but not limited to motors, starters, vibration isolators, air devices, etc. shall be of one manufacturer.
- E. All equipment, materials and devices for which a label service is available shall bear the label of the Underwriters Laboratory, Inc. (UL).
- F. All pressure vessels shall conform to ASME Code, State Codes and Requirements and shall be constructed, inspected and stamped accordingly.

2.2 WORK DESCRIPTION

- A. In general, the work shall consist of but not necessarily be limited to the following:
 - 1. Demolition, removal and replacement, and relocation as noted herein.
 - 2. Piping systems for heating hot water, drain and relief including related valves, fittings, strainers, air vents, and accessories.
 - 3. AC condensate drain traps and piping.
 - 4. Supply, return, and exhaust system including ductwork, grilles, registers, diffusers, constant and variable volume units, sound traps and accessories.
 - 5. All automatic temperature control as specified herein.
 - 6. Insulation of all piping, ductwork and equipment as specified herein.
 - 7. Packaged gas-fired rooftop units with curbs.
 - 8. Outdoor equipment casing with heating coil, piping chase and curb.
 - 9. Electric steam humidifier and appurtenances.
 - 10. Vibration isolation.
 - 11. Motor starters and variable frequency drives as specified herein.

12. Miscellaneous pipe, fittings, valves, hangers, anchors, sleeves, plates, flashings, pressure gauges, thermometers, and appurtenances necessary and required for a complete installation leaving same ready for service.
13. Test, adjust and balancing of all piping, ductwork and equipment.
14. Pipe, and valve marking and tags. Painting as noted herein.
15. Instruction and equipment manuals. Instruction of Owners representatives.
16. Temporary heat in accordance with restriction on early use of HVAC equipment.

2.3 WORK INCLUDED

- A. In addition to work described above under WORK DESCRIPTION, the work shall include but not necessarily be limited to the following:
 1. Provide removals, relocations, alternations and additions to existing HVAC equipment and systems as shown on the Drawings. For removals and demolition refer to Article: REMOVAL OF EXISTING EQUIPMENT AND MATERIALS.
 2. Connection to control terminals of switchboard and devices supplied under Division 26 for all pilot devices and ATC is to be provided under this Division.
 3. Rigging of equipment and materials related to HVAC work.

2.4 REMOVAL OF EXISTING EQUIPMENT AND MATERIALS

- A. Remove all superfluous piping, devices, controls, equipment, etc. Where removals are shown on Drawings, they are a general indication only, and may not necessarily indicate the full extent of the work. Where it is noted to remove existing piping, all associated fittings, valves, hangers, supports, insulation, etc. shall also be removed. Unless otherwise indicated piping shall be removed back to the mains and the remaining outlets plugged or capped. Coordinate with Division 02.
- B. No existing equipment or material shall be reused without specific approval of the Owner's Representative.
- C. All equipment and material to be removed, and not desired by the Owner, shall be removed from the site by the Contractor.
- D. Any removed material which is desired by the Owner shall be moved to an on-site storage location by the Contractor.
- E. Any and all shutdowns shall be scheduled with the Owner and performed at such times as the Owner may direct. Required premium time shall be included in the Contractors bid.
- F. All equipment and materials removed and not wanted by the Owner shall become the property of the Contractor and he shall remove them immediately from the site and dispose of unwanted material and equipment in a legal manner.

2.5 CHASES AND OPENINGS

- A. Provide information to the appropriate trades regarding size and location of all openings and chases as required for the installation of this HVAC Work.

2.6 CUTTING AND PATCHING

- A. Cutting and chasing for installation of HVAC work will be a part of the work of this Contract.
- B. Patching and repair of finishes will be by the General Contractor. Refer to Specification Division 09 – Finishes and Section 01 17 00 – Execution and Closeout Requirements.
- C. Provide sleeves for pipes passing through poured concrete decks, footings, walls, etc. Cut all openings for piping passing through precast concrete or existing concrete or masonry. Such holes shall be cut with core drill or similar equipment. They shall not be cut with hammer and chisel, or with any power tool depending on impact for its cutting power.

2.7 ELECTRICAL WORK

- A. All electrical work shall be done in strict accordance with the requirements of the National Electrical Code and the Electrical Specifications. All electrically operated equipment shall bear an Underwriter's Laboratories label where labeling service is available for that type of equipment.
- B. All motor frames shall be grounded. Electric power, control and grounding connections shall be factory wired to an outlet box or terminal strip enclosure on the apparatus for easy connection by the Electrical Contractor.
- C. Motors for use on equipment with variable speed drives shall be compatible for drive usage and be constructed per NEMA Standard MG-1 Part 31. Coordinate with variable speed drive manufacturers for motor requirements and drive output characteristics. All such motors shall have their cases bonded to the driven machinery frame with a ground strap.
- D. Disconnect switches shall be furnished by the equipment manufacturer. If disconnect switches are not available from the equipment manufacturer they shall be provided by the Electrical Contractor. Coordinate with the electrical drawings and specifications.
- E. Disconnect switches shall be as specified within the equipment specifications and shall suit the environment in which installed.
 - 1. NEMA 1: Indoor application no water. Factory standard.
 - 2. NEMA 3R: Outdoor application falling rain water.
 - 3. NEMA 4: Outdoor application hose directed water.
 - 4. NEMA 4X: Same as NEMA 4, but corrosion resistant.
 - 5. NEMA 7 and 9: Explosion resistant indoor and outdoor use.
 - 6. NEMA 12: Industrial use, dust-tight and drip-tight, oil resistant for indoor use.

2.8 WIRING FOR CONTROL SYSTEMS

- A. This Article applies to wiring used for Automatic Temperature Control (ATC), Building Automation Systems (BAS), and similar types of control systems associated with work of Division 23.

- B. All wiring for control systems shall comply with Article 725 of the National Electrical Code, (NEC) or with Articles 760, 800, or 820 for control systems integrated into systems covered by those Articles.
 - 1. Particular attention shall be given to the requirements of the NEC for testing and labeling cables for use in plenums, risers, and other air-handling spaces.
- C. All wiring for control systems shall be of a type recommended by the system manufacturer, and be installed in accordance with systems manufacturer's instructions.
- D. Cables must be in raceway when run through inaccessible ceilings, walls or chases. Comply with Division 26 Specifications for types of raceways required and their installation requirements. Cables run on surfaces within 8 feet of finished floor must be in raceways where exposed to physical damage. Cables in mechanical spaces must be in raceways.
 - 1. Where cables enter or leave raceways, provide insulated bushing or protective grommet.
- E. Cables may be run without raceways above accessible ceilings; in hollow stud partitions; and where properly supported in unfinished spaces without ceilings.
- F. Cables run without raceways in concealed locations or unfinished spaces shall be supported by bridle rings or similar hangers attached to the building structure at maximum 5 feet -0 inch centers. Hangers and/or cables shall not be supported from pipes, ducts, or similar equipment. Cables shall not be supported by lying on or across framing members or structural elements.
- G. Where cable is run exposed in finished areas, it shall be supported by bridle rings and beam clamps at maximum 4 foot intervals. All cables running along a given beam, joist, or truss shall be bundled together and run parallel to each other. Bundle shall be tied together at 2 foot intervals with T&B "Ty-raps" or equal nylon -cable tie. Ty-raps shall be exposed one foot on either side of bridle ring supports. Cables shall be pulled as tight as possible and run as straight as possible.
 - 1. Where cables bend, bends shall be 90 degrees; parallel cables shall have symmetrical turns. Bending radius shall be no smaller than manufacturer's specification for level of cable involved. Individual cables shall be supported with metal straps listed for the purpose. All cables shall be run parallel with or perpendicular to building lines, plumb and true. Cable loops connecting to boxes or fittings shall be as short and neat as possible.
 - 2. See details on Electrical Drawings for general information regarding cable support. All cables run on steel structure will be painted to match steel; cable supports, ties, etc., must be installed prior to painting.
 - 3. Cables shall be maintained at a spacing of 6 inches from 120 V and higher voltage AC conductors, unless installed in a grounded metallic raceway.
- H. Wiring with or without raceways shall be run continuously between terminal boxes and outlets. All splices shall be made in NEMA 1 boxes with terminal strips or other acceptable connectors and permanent labels to identify each wire and cable, both entering and leaving the box.
- I. A separation of not less than 6 inches shall be maintained to heated pipe lines.
- J. Cable run above hung ceilings used for environmental air shall be specifically listed and labeled for the use or shall be installed in a raceway.

- K. Wiring run without raceways through rated walls, floors and partitions shall be run in sleeves. All such sleeves shall be packed with fire-rated material.
- L. Wiring for different systems shall be grouped and run separately from other systems, and shall be identified as to the system it serves.
- M. Where equipment to be provided is controlled with line voltage devices (thermostats, speed controllers, timers, etc.), these devices shall be furnished to the electrical contractor for mounting and wiring of same.
- N. All electrical wiring in connection with the BAS shown on the electrical drawings shall be installed by the Electrical Contractor. Any wiring not shown but required for proper operation of the automatic temperature control system, shall be performed by the Control Contractor and shall be in complete accordance with National Electrical Code, latest edition and the Electrical Contract Specifications.

2.9 SUBSTITUTIONS

- A. Comply as applicable with Product Requirements or as indicated in each product specification.
- B. Equipment may be shown or specified in several ways:
 - 1. Manufacturer and catalogue or model number with the words "no substitutions," "no equal," "(manufacturer) only," or words of similar respect. Contractor shall furnish the specified item.
 - 2. Several manufacturers and model numbers listed; or one manufacturer and model number, followed by "equals by (mfr A), (mfr B), (mfr C)," or words of similar respect.
 - a. If one of the manufacturers is listed on the drawings, that manufacturer shall be considered the basis of design. If none is so listed, the first manufacturer named in the Specification shall be considered the basis of design.
 - b. Where manufacturer's or supplier's name, style and catalog numbers are mentioned in the description of material and equipment in the specifications or on the drawings, it is to be understood that they are for the purpose of setting a standard.
 - c. If Contractor elects to furnish equipment other than the basis of design, he shall verify capacities, physical size, weight, electrical requirements, methods of connection to other parts of the system, and all other relevant data. Contractor shall be responsible for informing the Design Professional of all changes required to other equipment, spaces, structure or systems in order to install the substituted equipment. He shall furnish all required shop drawings or sketches required for Design Professional to evaluate the required changes, and shall be responsible for all costs associated with such changes, including costs of design or engineering, if such are necessary, and costs of other trades.
 - 3. Where manufacturer's or supplier's names are listed in conjunction with the manufacturer or supplier that is basis of design, they are given to approve the firm name only. Equipment or material submitted by such firms must meet the detailed technical specifications written for the respective item. Contractor shall be responsible for verifying capacities, physical sizes, weights, electrical requirements, and methods of connection to other parts of the system, etc. Contractor shall furnish all required shop drawings for equipment, and for its connection and installation.
- C. If any substituted items are submitted after contracts have been awarded, and there is any question of equality of such items, samples may be required to be submitted both for the item specified and that to

be substituted, or, further proof of equality may be required to the entire satisfaction of the Design Professional. In no case shall additional remuneration be allowed because of the rejection of a substitute.

- D. When the equipment is relocated to a place other than that shown on the drawings, or when equipment other than that specified is used, the Contractor shall pay the extra cost of required revisions such as structural steel, concrete, electrical, piping, etc.
- E. The Owners costs associated with additional Engineering and revisions to the Drawings and Specifications associated with evaluating substitutions shall be borne by the Contractor in the form of credits to appeal of the Contractors Application for Payment.

2.10 SHOP DRAWINGS

- A. Refer also to Division 00, 01 and other Division 23 sections.
- B. Furnish shop drawings, catalog cuts, performance data and other required data to the Design Professional for approval for all material and equipment specified hereinafter. Sufficient data shall be submitted to show compliance with the requirements of the plans and specifications. All shop drawings submitted shall be first checked and corrected before submitting for approval. Approval for shop drawings by the Design Professional will not relieve the Contractor from responsibility for errors or omissions therein. All such errors or omissions must be made good by the Contractor irrespective of any approval by the Design Professional.
- C. Each shop drawing submitted shall be identified by the Project Name, Specification Section, and Drawing Numbers.
- D. Each submittal shall be required to bear the review stamp of each Contractor associated with the processing of the document. The processing of shop drawings shall follow contractual relationships between the Prime Contractor and all Sub-contractors
- E. Shop drawings which require coordination of two or more trades shall be required to bear the stamp of coordinating trades. Sheetmetal, ductwork, because of its bulkiness, shall take precedence.
- F. On submissions beyond the initial one, clearly identify changes made from the initial submittal other than those requested by the Design Professional. The Design Professional will review only those changes he requested and those identified by the Contractor.
- G. Shop drawings required shall include, but not necessarily be limited to, the following:
 - 1. Shop drawings, cuts and catalogue information showing appearance, dimensions, performance, weight, etc., of all equipment, appurtenances, etc.
 - 2. Schedules of all materials showing type and manufacturer.
 - 3. Wiring diagrams and schematics for equipment.
 - 4. All special equipment and systems.
 - 5. Any special constructions.
 - 6. Other shop drawings as may be requested.
 - 7. Ductwork shop fabrication drawings. See also the requirements in Part 3 of this Specification Section.

- H. Digital files of mechanical work will not be provided for the purpose of shop drawing preparation. Digital files of architectural plans, elevations, sections, etc. may be available for background purposes; it is the responsibility of the Contractor to confirm availability prior to bid.
- I. Facsimile submission of shop drawings will not be accepted as the submittal format. An advanced copy for starting the process may be faxed but hard copy submittals are to be submitted for actual review.
- J. Electronic submission of shop drawings shall be permitted in the format as indicated by the Architect per Division 00 and 01.
- K. Shop drawings shall be submitted in a timely manner, taking due account of time requirements for processing, correcting and distributing the shop drawings to all persons or trades requiring the information, as well as time required for manufacture of the equipment. Design Professional will not be responsible for construction delays resulting from late submission of shop drawings, nor for delays caused by the need to correct and resubmit shop drawings which were not correct, which involved substituted equipment, or otherwise required review, correction and resubmission.
- L. If Contractor elects to proceed to install equipment for which approved Shop Drawings have not been received, he does so at his own risk; Design Professional is not obligated to accept such equipment or work, nor will Design Professional be liable for claimed costs or delays required by correction of such work.
- M. Multiple pieces of materials and equipment such as valves, pumps, insulation, air devices, etc. shall be of one manufacturer.

2.11 SECONDARY AIR CONDITIONING CONDENSATE DRAIN PANS

- A. Secondary AC condensate drain pans shall be provided under all systems with cooling coils that are suspended above ceilings.
- B. Drain pans shall be constructed of galvanized 18 gauge sheet metal with 1-1/2 inches turned up hemmed sides with all joints and seams sealed water tight. Provide channel or angle steel reinforcement as necessary. Support pans with unistrut trapeze hangers and rods connected to the building structure.
- C. Provide moisture sensor connected to BAS as specified elsewhere herein.

PART 3 EXECUTION

3.1 VISIT THE SITE

- A. Before submitting bid, visit the site of the work and be thoroughly familiarized with the conditions affecting the work. No extra payment will be allowed on account of extra work made necessary by failure to do so.

3.2 WORKMANSHIP

- A. All work shall be installed in a first class, neat and workmanlike manner by mechanics skilled in the trade involved. All details of the installation shall be mechanically correct. Should the Design Professional direct removal, change, or installation of any equipment or systems not installed in a neat and workmanlike manner, such changes shall be made by the HVAC Contractor at no expense to the Owner.

- B. Equipment shall be installed in strict accordance with manufacturer's instructions for type and capacity of each piece of equipment used. The Contractor shall obtain these instructions from the manufacturer and these instructions shall be considered part of these Specifications.
- C. Drawings are generally indicative of the work to be installed, but do not indicate all bends, offsets, fittings, valves, traps and specialties which may be required, or the exact locations of all piping and ductwork. Contractor shall investigate structure and finish conditions affecting his work and arrange his work accordingly; furnishing such items as may be required to meet such conditions. Contractor is responsible for exercising proper judgment to arrange his work and materials so as to avoid interference with other trades.
 - 1. Riser diagrams and schematics generally indicate equipment to be used in various systems involved. This information may or may not be duplicated on the plans, but equipment shown on either plans or riser diagrams and schematics shall be provided as if shown on both.
 - 2. All grades, elevations, dimensions and clearances of equipment shown on drawings are approximate and shall be verified at site.
 - 3. Where work or equipment is referred to in singular terms, such reference shall be deemed to apply to as many items of work or equipment as required to complete entire installation.
- D. All piping shall be installed so as not to interfere with any electric lighting outlet, ductwork, other piping or equipment. No piping shall pass in front of or interfere with any opening, door or window. Headroom in front of such openings and doors shall not be less than the top of the opening. Contractor shall not install piping with valves, joints or fittings over any motor, transformer, electrical switchboard or equipment.
- E. All piping and other work required by these specifications and by applicable drawings will be laid out and installed with complete work of all trades in mind. The Contractor is cautioned that close coordination between the trades will be required for the successful completion of the work, and in case interference with the work of other trades should develop, The Design Professional shall determine which work is to be relocated, regardless of which was first installed at no additional expense to Owner.
- F. All piping and other work shall be installed so as to preserve access to all valves, traps and other parts requiring access or servicing.
- G. All piping valves and fittings shall be kept a sufficient distance from other work to permit a clearance of not less than one (1) inch between the finished covering on such ducts, piping, valves and fittings, and all adjacent work. Particular attention shall be given to this requirement in regard to piping at all major equipment.
- H. Pipes shall be cut accurately to measurements established at the job site and shall be installed without springing or forcing. Changes in direction or reduction in size shall be made with standard fittings. No mitering of pipe to form elbows or reducers will be permitted. Before erection, all piping shall be thoroughly cleaned and, if necessary, after erection to remove any foreign matter. Remove all burrs and sharp edges from piping.
- I. All water piping systems shall be installed in such manner that systems can be drained or vented completely. Provide manual air vents at high points and drain valves at low points. Piping to all fixtures and equipment shall extend from the top of the mains as indicated on drawings and all branches shall be valved in the horizontal run off at the mains. All hot water piping shall be installed with expansion loops or expansion joints as indicated on the drawings and shall pitch up in the direction of flow.

- J. For connections to existing systems, the Contractor shall drain all existing piping systems, as required, to make new connections to the systems. After the work is completed, the existing systems shall be refilled, purged of all air, and operated to assure that they function properly. Connections to existing systems shall be made using any of the following methods as applicable:
 - 1. Drain system first and then make connection.
 - 2. Wet-tap method.
 - 3. Quick freeze method.
- K. All un-insulated piping and ductwork exposed in occupied areas must be provided with heavy, solid pattern, painted escutcheons where such materials pass through wall, floors, or ceilings. Escutcheons are not required in equipment rooms or unfinished areas.
- L. Installation of valves, dampers, equipment and devices shall provide full accessibility for service and maintenance.

3.3 LINES AND GRADES

- A. Layout work and establish heights and grades for work in strict accordance with the intent expressed by the drawings and all the physical conditions at the building and be responsible for the accuracy of same.

3.4 FIELD MEASUREMENTS

- A. Before ordering any material or doing any work, verify all measurements at the building and site and be responsible for the correctness of same. No extra compensation will be allowed on account of differences between actual dimensions and measurements and those indicated on the drawings. Any difference which may be found shall be submitted to the Design Professional for consideration before proceeding any further with the work.

3.5 DELIVERY OF EQUIPMENT

- A. Be responsible for delivery of equipment, unload and store in a manner not to interfere with the operation of other trades. Additional expense incurred because of equipment or material delivery delays shall be assumed by the responsible Contractor.

3.6 RESTRICTIONS ON EARLY USE OF HVAC EQUIPMENT

- A. The HVAC equipment provided under this contract shall not be operated prior to the completion of construction of the building for reasons other than testing and balancing of the systems, unless specifically directed and/or approved by the Owner. This specifically prohibits the use of permanent equipment for the purposes of ventilating, heating and dehumidifying the building while under construction.
- B. Should a contractor choose to use any component of the permanent HVAC system (i.e. chillers, pumps, air handlers, chilled beams, etc.) for purposes other than stated above, he shall assume full responsibility for replacing or repairing any equipment material or finishes, damaged as a result of the use and pay all costs associated with the action required to make the equipment in "like new" conditions at the end of the project. This includes cleaning of ducts and coils, provide MERV 8 filters in air handling equipment during operation, replacement of motors, extension of warranties, payment of design professional fees required to investigate and enforce this requirement, and the correction of any other detrimental

conditions which is determined by the design professionals to be related to the early use of the equipment. Provide at unit turnover specified MERV filters but not less than MERV 13.

- C. Should the early use of equipment result in manufacturer's warranty being void, the contractor shall assume the cost of furnishing an equivalent warranty to the Owner.
- D. Should fan motors be operated during construction, any motor determined by the owner or design professional to be exposed to airborne construction dust, such as generated by drywall sanding, shall be inspected by an independent 3rd party for damage. The costs of all required corrective actions shall be borne by the contractor responsible for the operation of the equipment.

3.7 PROTECTION OF WORK

- A. All work, equipment and materials shall be protected at all times.
- B. All piping openings shall be closed with caps or plugs during installation. All equipment shall be tightly covered and protected against dirt, water, plaster, paint and other foreign material or mechanical injury during entire progress of installation. Make good all damage caused either directly or indirectly by workmen employed to fulfill requirements of the HVAC work.
- C. Chilled beams and fan powered boxes shall be protected from construction dust until time of operation.

3.8 REMOVAL OF RUBBISH

- A. During the course of construction, periodically remove from the premises all rubbish resulting from work of this trade so as to prevent its accumulation. At the completion of the work contemplated under these Specifications remove from the building and site all rubbish and accumulated materials of whatever nature not caused by the other trades and leave work, and equipment free of all foreign matter including plaster, cement, and paint and leave in a clean, orderly, acceptable and usable condition.

3.9 COORDINATION WITH OTHER TRADES

- A. Work in conjunction with each of the other trades to facilitate proper and intelligent execution of work with minimum interference.
- B. Carefully examine all architectural and structural drawings for the building and drawings for electrical trade and other mechanical trades and be responsible for the proper fitting of all material and equipment into the building as planned and without interference with other piping, ductwork, conduit or equipment. Proper judgment shall be exercised to secure best possible headroom, door and window clearance, and space conditions throughout; to secure neat arrangement for piping, equipment and conduit; and to overcome all local difficulties and interferences to best advantage. Approval for any and all changes to plans and specifications which may thus be incurred shall be obtained from the Design Professional before proceeding.
- C. Contractor shall prepare preliminary sheet metal shop drawings suitable for use in coordinating his work with the work of other trades. The Mechanical Contractor shall prepare and furnish CAD files of drawings at 3/8" = 1'-0" scale illustrating the coordination with all trades. Drawing shall indicate equipment access requirements, piping, ductwork and conduit in relation to all structural elements of the construction, including floor elevations; steel locations, size, and elevations; partitions locations; door locations and direction of swing; and all other information required to assure coordination of the electrical, sheet metal and piping trades and fire protection in relation to the Architectural function of the project.

Coordination meetings shall be held under the supervision of the Owner's Construction Manager and General Contractor.

- D. Each trade shall have proper representation at all coordination meetings for the purpose of detailing, on a print of the coordinated drawing mentioned above, the exact location and routing of their work sheetmetal ductwork, because of its bulkiness, shall take precedence. After the conclusion of the coordination at the working meetings, each trade shall sign the coordinated print, copies of which shall be distributed by the GC to all contractors and parties concerned including the Owner. A print of each final coordination CAD drawing with the participants contractors "signoff" signatures appended shall be submitted to the design professional for record.
- E. If contractor installs work so as to cause interference with work of other trades, he shall make necessary changes in work to correct the condition without extra charge.
- F. Dimensional layout plans of equipment rooms shall be made showing all bases, pads and inertia blocks required for mechanical equipment. Include dimensions of bases, bolt layouts, details, etc.
- G. Contractor shall furnish all necessary templates, patterns, etc. for installing work and for purpose of making adjoining work conform, furnish setting plans and shop details to other trades as required.

3.10 COORDINATION OF CONTROL EQUIPMENT

- A. The HVAC Contractor shall furnish all starters, push buttons for local or remote control, controllers, pressure switches, aquastats, thermostats, float switches or similar items together with all appurtenances and accessories required to operate the equipment furnished under these specifications and necessary to perform the operating functions as specified, shown on the drawings, or otherwise required.
- B. The Electrical Contractor will mount and provide power-wiring for all starters and will furnish and install all other safety switches or other line-disconnecting or protective devices. Where the starter and/or safety switch is an integral part of the equipment assembly, the assembly shall be furnished with the wiring complete between starter, controller and motor and the Electrical Contractor will make power connections only.
- C. All control wiring to automatic-operated switches, pressure switches, aquastats or other devices which actuate the starter or other items associated with the systems shall be furnished, installed and wired by the HVAC Contractor. The Electrical Contractor will supply 120V electric power to the control panels for these special systems to the extent shown on Electrical Drawings. All other wiring (including additional power circuit if required) shall be the responsibility of the HVAC Contractor.
- D. The HVAC Contractor shall carefully check the current characteristics available to each location before ordering motors.
- E. If procurement requirements necessitate a change in voltage, phase, horsepower or other characteristics of any motor, the HVAC Contractor shall obtain approval of such change from the Design Professional and shall be responsible for necessary arrangements for notifying the Electrical Contractor, and shall pay the costs, if any, required by the change, including Engineering costs.

- F. All electrical equipment furnished and installed under this contract shall be furnished with full complement of control equipment, control wiring, conduit and all other items necessary for satisfactory operation.
- G. The Electrical Contractor will complete all electrical power connections, through the disconnect and/or thermal cutouts, starter and motor terminals. He will be responsible for final power connections.
- H. The Electrical Contractor will be responsible for proper rotation of three phase equipment.
- I. All electrical work, equipment and material furnished under this Section shall be furnished and installed in accordance with the Automation Specifications – Division 25 and Electrical Specifications – Division 26.
- J. All panels, relays, terminal boxes, contactors, circuit breakers, safety switches, motor starters and similar items shall be identified by Name, Function and/or Control. Nameplates shall be at least 1 inch x 3 inches with characters not less than a ¼ inch. They shall be made of two laminated black plastic sheets bonded with a middle sheet of white plastic and characters engraved in one black sheet to the depth of the white plastic. A typewritten list of nameplates shall be submitted to the Design Professional for approval before ordering same.

3.11 EXPANSION OF PIPING

- A. All piping connections shall be made so as to allow for perfect freedom of movement of piping during expansion and contraction, without springing or creating air pockets which will impair the flow of the water through the system. Install expansion loops as shown on the drawing or as required. Expansion loops shall be made with swing joints, bends or long offsets as necessary. Provide expansion guides.
- B. Use expansion loops in lieu of expansion joints. The desired methods of expansion compensation in underground steam piping, in order of preference, are as follows:
 - 1. Loops
 - a. All loops shall be constructed with long radius elbows welded into the line.
 - b. All loops must be subjected to cold spring during installation to approximately one-half of the total compensation between hot and cold conditions.
 - 2. Ball joints
 - 3. Telescoping slip joints

3.12 ANCHORS AND GUIDES

- A. Anchors and guides shall be provided where shown and/or required for the proper control of stress in piping due to expansion.
- B. Securely anchor all piping utilizing expansion loops to the building structure with steel angles, properly braced and welded to the pipe. The projects' Structural Engineer shall review all loads imposed upon the structure by the piping system. The Contractor shall be required to submit shop drawings detailing the proposed anchors for review.
- C. All piping which must be provided with expansion loops shall be fitted with pipe guides in the quantity and spacing recommended by the manufacturer. Guides shall be firmly attached to the building structure.

3.13 ACCESS

- A. All equipment requiring maintenance or adjustment must be accessible. Items located above ceilings shall be located above accessible portions of the ceiling or above access panels provided by this Contractor. Manufactured items with internal components requiring access (whether integral with the enclosure or not) shall be provided with access panels. Access panels shall be provided in ductwork where required for maintenance or adjustment of internal components.
- B. Provide access panels in walls and ceilings to give access to all cleanouts, fire dampers, automatic and manual volume dampers, valves, temperature control equipment, junction/pull boxes, and other similar mechanical, plumbing, fire protection, and electrical devices which could otherwise be inaccessible.
- C. In unplastered masonry block walls, the height of the panels shall be a multiple of the height of the block courses. All access panels shall not be smaller than 12 inches wide by 18 inches unless otherwise indicated or directed, and they shall be installed flush with the finished wall or ceiling and shall be painted with not less than two coats of paint to match adjacent surfaces.
- D. In fire rated assemblies the access panels shall be fire rated.

3.14 FIRE STOPPING

- A. All penetrations through fire-resistance-rated floor, fire resistance rated, floor/ceiling assemblies and roof construction and through fire-resistance-rated walls and partitions shall be fire stopped.
- B. Penetrations to be fire stopped include both empty openings and those containing cables, pipes, ducts, conduits and any other items.
- C. Fire rating of sealed penetrations shall meet or exceed the rating of the assembly being penetrated.
- D. Materials shall be installed in accordance with manufacturer's recommendations and their UL listing.

3.15 IDENTIFICATION OF MECHANICAL EQUIPMENT AND PIPING

- A. All equipment shall have securely attached a manufacturer's nameplate giving complete data as to design and operating characteristics. Nameplates shall not be painted covered or otherwise concealed or obscured.
- B. All operating equipment, switches, starters, safety switches, panels, junction boxes, breakers, gauges, control devices and similar equipment shall be identified and shall have nameplates giving the name and number of the item of equipment. Nameplates shall be two tone printed white paper enclosed in a transparent, laminated, plastic case with permanently sealed edges. Nameplates shall be securely attached to the equipment or where this is not practicable they shall be attached by brass link chains.
- C. All new piping throughout and all reinsulated piping shall have legends giving the nature of service, as for example "Cold Water Piping", together with arrows indicating the direction of flow. Characters shall be not less than 1½" high generally, and not less than 2" where the pipes are 10' or more above the floor. Legends and arrows shall be placed adjacent to each other and at any change of direction, and intermediately not over 30' apart. Pipe identification shall be manufactured by Wilmington Plastic Co., Brady Co. or Seton Corp. with colored paper laminated between (2) two Vinylite sheets. Coloring shall be ASME Code color. Coordinate with Section 23 05 23 for all tagging and identification requirements.

3.16 VALVE TAGS

- A. Each valve furnished under this section of the contract shall be identified by an approved tag attached to the valve with a brass chain. Tag shall be brass two (2) inches in diameter with the following information typed thereon: Valve number, valve size, and service of the valved line. Coordinate with Section 23 05 53 for all tagging and identification requirements.
- B. The Contractor shall prepare lists of all valve tags giving the number and location of each valve, valve size, service of valved line, and the equipment or portion of the system controlled. The lists shall indicate the piping services and shall be prepared with consecutive numbers for all valves within the same zone.
- C. This Contractor shall furnish two (2) sets of all valve tag lists framed under glass in a metal or hardwood frame and hung where directed. In addition, the Contractor shall furnish two (2) bound copies of all valve tag lists prepared in directory form as approved.

3.17 TESTING AND ADJUSTING – MECHANICAL

- A. All new heating hot water supply and return piping shall be tested and proven tight under hydrostatic pressure of not less than 1.5 times the operating pressure, but not less than 150 psig, measured at the lowest points in the systems. Tests of concealed piping shall be made before the piping is closed in. Test pressure shall be held for a period of 24 hours without any loss of pressure. Leaks in threaded fittings shall be corrected by remaking the joints. Caulking of leaks will not be permitted. Tests shall be conducted again if required by The Design Professional. The Contractor shall notify The Design Professional, or Owner's representative 24 hours prior to any hydrostatic test and test shall only be performed in the presence of and approved by Owner's representative. Tests shall be made before any non-conductive covering is applied.
- B. The Contractor shall comply with all rules and regulations, local codes and the requirements of the utility companies pertaining to tests and shall perform all tests including the furnishing and installing all necessary fittings and equipment required to complete all tests.
- C. All equipment shall be adjusted so that they will perform as specified and as required to give satisfactory operation.
- D. All tests shall be made before piping is covered or concealed. Any leaks appearing shall be repaired to the satisfaction of The Design Professional.
- E. Before the systems are adjusted, tested or placed in operation, all piping and equipment shall be cleaned of all dust, dirt and other debris, so that no dirt will be carried into the system.
- F. Mechanical and BAS contractors shall coordinate with Owner retained third party provider.

3.18 OILING AND SERVICING

- A. All bearings and packing glands shall be properly protected during installation. Before the equipment is placed in operation, they shall be filled with the type of lubricant recommended by the manufacturer of the apparatus. Prior to final acceptance, all equipment glands shall be repacked and all valve packing glands tightened.

- B. At completion of the work, prior to its operation by Owner, all strainers shall be cleaned and overload devices in motor starters shall be replaced or adjusted as required for proper operation and protection of the motors. All damage to the insulation or finish of any part of the work resulting from the final adjusting of the equipment shall be repaired to match the new condition of the work.
- C. All repair work shall be done by mechanics of the trade who originally installed the work.
- D. All water-filled systems shall be equipped with accessible vent valves, expansion tanks, drains and isolation valves, safeties, and gauges for the purpose of startup, operation, service and maintenance in a cost effective manner.
- E. Wear and tear parts which are equipment-specific will be specified and quoted with life expectancy, lead and time and price.
- F. An extended 5 year warranty shall be included on the wear and tear parts which are equipment-specific. A list of components fitting this description shall be forwarded to the Project Manager prior to Project Closeout.
- G. Include all specialized equipment or tools required to service or maintain the equipment.
- H. Lubrication (per manufacturer's recommendation):
 - 1. Each Contractor shall be responsible for the initial lubrication of all equipment prior to equipment start-up.
 - 2. A list of all equipment requiring lubrication, including the identification of all specific points of lubrication shall be produced and forwarded to the Owner.
 - 3. Each Contractor shall be required to furnish written instructions on the lubricating procedure and shall furnish not less than a one year supply of all necessary lubricants.

END OF SECTION 23 05 00

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SECTION 23 05 03 – PIPES AND TUBES FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes: Pipe and pipe fittings for the following systems:
 - 1. Heating hot water piping.
 - 2. Refrigerant piping.
 - 3. Equipment drains, vents and overflow piping.
 - 4. Unions, flanges, gaskets and fittings.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 - Malleable Iron Threaded Fittings.
 - 2. ASME B16.4 - Gray Iron Threaded Fittings.
 - 3. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 5. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 6. ASME B31.1 - Power Piping.
 - 7. ASME B31.9 - Building Services Piping.
 - 8. ASME B36.10M - Welded and Seamless Wrought Steel Pipe.
 - 9. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- B. ASTM International:
 - 1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 3. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - 4. ASTM A536 - Standard Specification for Ductile Iron Castings.

5. ASTM B32 - Standard Specification for Solder Metal.
 6. ASTM B68 - Standard Specification for Seamless Copper Tube, Bright Annealed.
 7. ASTM B75 - Standard Specification for Seamless Copper Tube.
 8. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 9. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 10. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 11. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
 12. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot-and Cold-Water Distribution Systems.
 13. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- C. American Welding Society:
1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
 2. AWS D1.1 - Structural Welding Code - Steel.
- D. American Water Works Association:
1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 2. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
 3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 4. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- E. National Fire Protection Association:
1. NFPA 30 – Flammable and Combustible Liquids Code.
 2. NFPA 31 – Standard for the Installation of Oil-Burning Equipment.
 3. NFPA 54 – National Fuel Gas Code.
 4. NFPA 58 – Liquefied Petroleum Gas Code.

1.4 SUBMITTALS

- A. Comply as applicable with submittal procedures.
- B. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, and sizes.
- C. Product Data: Submit data on pipe materials and fittings. Submit manufacturers catalog information.
- D. Welders' Certificate: Include welders' certification of compliance with ASME Section IX. And AWS D1.1.

1.5 SUBSTITUTIONS

- A. Comply as applicable with Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.
- C. Provide line item pricing costs for optional piping method and material if used. Option will be rejected if costs are not provided at time of bid.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.1 and ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- B. Each length of piping and each fitting shall be legibly identified at the mill by paint, stenciling or raised symbols identifying the manufacturer and class of pipe.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum five years experience approved by manufacturer.
- C. Design pipe hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of PA.

1.8 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with pre-installation meeting requirements.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with requirements for transporting, handling, storing, and protecting products.
- B. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Comply as applicable with environmental conditions affecting products on site.
- B. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 COORDINATION

- A. Comply as applicable with requirements for coordination.

PART 2 PRODUCTS

2.1 SERVICES

- A. Piping utilized for the services listed below shall be per ANSI / ASME B31.1 Code for Pressure Piping, ASTM A-106 or A-53 Grade B and dimension standards of ANSI B36.10, Schedule 40 ERW carbon steel pipe up to 6-10 inch and standard wall 12 inch and larger:
 - 1. Heating Hot Water
- B. All piping 4 inches and smaller utilized for the services listed below shall be hard drawn Type L copper tubing per ASTM B88, except cooling coil condensate shall be type DWV. Fittings shall be wrought iron copper, per ANSI B16.22, except cooling coil condensate piping shall be wrought copper per ANSI B16.29.
 - 1. Heating hot water
 - 2. Refrigerant piping
 - 3. Relief
 - 4. Vents and drains

2.2 FITTINGS

- A. Fittings for steel piping 2" inch and smaller shall be screwed or welded type. Fittings for steel piping 2-1/2" inch and above shall be welded or flanged type and shall be short or long pattern seamless butt welded fittings of the same wall thickness and of the same material as the pipe to which they are attached.
- B. Steel fittings shall have pressure ratings (psi) as indicated or as required to meet system operating pressures per paragraph E and F.
- C. Fittings for copper piping shall be made of the same wall thickness and of the same material as the pipe to which they are attached. Fittings shall be made from pure copper mill products per ASTM B75 Alloy C12200, meeting design standards ANSI B16.22 and MSS-SP-104. Fittings shall be rated for an internal

working pressure of 250 psi at 200 degrees F. Piping 4 inches and smaller shall be hard-drawn seamless copper water tubing ASTM B88-Type L.

- D. Fittings in copper tubing shall be wrought copper solder joint fittings or ProPress Pressure Fitting System as manufactured by Viega as follows:
1. Material:
 - a. Copper tubing shall conform to ASTM B75 or ASTM B88.
 - b. Copper fittings shall conform to ASME B16.18, ASME B16.22 or ASME B16.26.
 - c. Copper and copper alloy fittings shall conform to material requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS117. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press ends shall have SC (Smart Connect™) feature design (leakage path). In ProPress 1/2 inch to 2-1/2 inch dimensions, the Smart Connect Feature shall assure leakage of liquids from inside the system past the sealing element of an unpressed connection. The function of this feature shall be to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
 - d. Solder metal shall conform to the requirements of ASTM B32. Soldering fluxes shall conform to ASTM B813.
 - e. Pipe threads shall conform to ASME B1.20.1.
 - f. Hangers and supports shall conform to MSS-SP-58.
 2. Quality Assurance:
 - a. Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of ProPress copper press joint systems.
 - b. ProPress copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer.
 - c. The installation of copper tubing in Hydronic systems shall conform to the requirements of the ICC International Mechanical Code or the IAPMO Uniform Mechanical Code.
 - d. Piping shall comply with ASME B31.9 for building services piping valves.
 3. Delivery, Storage and Handling:
 - a. Copper tubing shall be shipped to the job site in such a manner to protect the tubing. The tubing and fittings shall not be roughly handled during shipment. The tubing and fittings shall be unloaded with reasonable care.
 - b. Protect the stored product from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.
 - c. Protect fittings and piping specialties from moisture and dirt.
 4. Project Conditions:
 - a. Verify length of tubing required by field measurements.
 5. Warranty:

- a. The tubing and fittings manufacturer shall warrant that the tubing and fittings are free from defects and conform to the designated standard. The warranty shall only be applicable to tubing and fittings installed in accordance with the manufacturer's installation instructions.
- E. Steel pipe fittings and flanges for operating pressures 150 lb. class psi shall be as follows:
 - 1. Screwed fittings shall be malleable carbon steel, 150 lb. class, black, and in accordance with ANSI B16.3, ANSI B1.20.1 and ASTM A126 class B.
 - 2. Flanged fittings shall be cast iron, short body, class 125 or 250, black and in accordance with ANSI B16.1.
 - 3. Weld fittings shall be forged steel schedule 40 up to 10 inches and standard wall 12 inches and larger, black, class 150, and in accordance with ANSI B16.9, ANSI B16.25, ASTM A234, ANSI B16.5, or ANSI B16.11.
 - 4. All flange bolting shall be ASTM A307 Grade B heavy hex bolts and stud bolts with ASTM A563 Grade A heavy hex nuts. Bolt and stud length shall be in accordance with ASME B16.5, Table 8. All bolt threads shall be lubricated with anti-seize thread compound.
 - 5. All slip-on flanges shall be back-welded.
 - 6. Make up flanges prior to completing last weld in connecting piping. Alignment of piping shall be correct without forcing, drifting, or bending.
 - 7. Make up joints with spiral wound gaskets by taking up bolts until flange faces touch centering rings. Record torque required for flange closure and re-apply after piping warm-up. Gaskets shall be full face 1/8 inch minimum thickness as here-in-after specified.
 - 8. After piping has been maintained at operating temperature for 48 hours, recheck bolting to restore initial bolt tension (torque).
- F. Before proceeding with welding, submit the following for review and approval:
 - 1. Proposed procedures conforming to latest revisions of:
 - a. ANSI B31.1, Code for Power Piping, Chapter V.
 - b. ANSI Z49.1, Safety in Welding and Cutting.
 - c. API Code for fuel and other API Codes governing welding piping.
 - 2. List of welding qualified per Section IX of ASME, Boiler and Pressure Vessel Code.
 - 3. Filed procedures: Clean pipe free from rust, scale and oxide. Bevel pipe on each end per acceptable procedures. Provide backing rings on steam and hot water over 100 psig. Utilize metered pipe and filed fabricated fittings only where noted and where especially permitted. Hammer clean and flush out piping after welding to remove scale, welding slag and other debris.
- G. Fitting application shall be as follows:
 - 1. The following piping shall be provided with low pressure fittings. (Below 125 psi operating pressure).
 - a. Heating Hot Water

- H. Fittings for screwed piping shall be Stockham, Grinnell/Anvil International or approved equal.
- I. Fittings for welded piping shall be Tube Turn, Taylor Forge or approved equal.
- J. In all cases where copper pipe connections are made to piping or equipment of a dissimilar metal a dielectric fitting shall be provided.

2.3 COPPER TUBING JOINTS

- A. Joints in copper tubing shall be made with non-corrosive paste flux and solid string or wire solder. Cored solder will not be permitted. Solder shall be lead-free type. Brazing alloy with melting point over 1000 degrees F shall be used for fuel oil piping. All solder for copper tubing shall have a melting point of not less than 460 degrees F., composed of 95% tin and 5% antimony, or brazing filler metal with melting at or above 1100 degrees F., (silver or copper-phosphorus) in accordance with the following table for water and other non-corrosive liquids and gases:

SAFE STRENGTH OF SOLDERED JOINTS

Maximum Service Pressure, PSI

Solder used in Joints	Service Temperature Degrees F.	1/4 – 1 inches Incl.	1-1/4 – 2 inches Incl.	2-1/2 – 4 inches Incl.
95-5 Tin-Antimony	100	1090	850	705
	150	625	485	405
	200	505	395	325
	250	270	210	175
Brazing Filler Metal	250	300	210	170
	350	270	190	155

- B. Refrigerant piping shall be assembled by brazing under a nitrogen purge using Handy and Harman Sil-Fos consisting of 15% silver, 80% copper, and 5% phosphorous having 1185°F melting point and 1300°F flow temperature.

2.4 PIPE APPLICATION SCHEDULE

X = Preferred Material

<u>Piping System</u>	<u>Copper (Type)</u>	<u>Steel Sch. 40</u>	<u>Steel Sch. 80</u>	<u>See Spec</u>
Heating Hot Water	X (L) <4 inch	X ≥ 4 inch		X > 12 inch
Refrigerant and Clg. Coil Condensate	X (L)			
Relief Drain & Vent Piping	X < 4 inch	X ≥ 4 inch		X > 12 inch
Make-up Water	X (K)			

2.5 GASKETS

- A. All flanged joints for water, steam and steam condensate piping shall be spiral wound metal with outer gauging, ASME B16.20, flexible graphite filler material, 304SS gauge ring, class 50 garlock style RW. Flexible Graphite Gaskets shall not be less than 1/8 inch thick, one gasket to each joint. One side of the gasket shall be painted with graphite and oil before being put into place.

2.6 UNIONS

- A. Manufacturers
 - 1. Stockham
 - 2. Grinnell/Anvil International
 - 3. Dart
- B. Unions 2 inches and smaller in copper tubing shall be standard weight, all brass, ground joint, for solder type connections. Unions 2 inches and smaller in steel pipe shall be of the screwed malleable pattern ground joint type with brass seat ring.
- C. Unions 2 1/2 inches and larger in copper tubing shall be cast bronze for solder connection per ANSI and ASME Standards. Unions 2-1/2 inches and larger in steel pipe shall be cast iron, or forged, per ANSI Standards B16.
- D. Unions shall be (150 psi swp, 300 psi wog).
- E. For Piping material other than steel or copper unions shall match piping material.

2.7 DI-ELECTRIC FITTINGS

- A. Manufacturers
 - 1. Watts Series 3000
 - 2. EPCO
 - 3. Victaulic
- B. Where connections are made between steel piping or ferrous equipment and copper tubing, provide union with a gasket of inert and di-electric material, Teflon or approved equal.
- C. Unions shall be rated at 210 degrees F at 250 psi conforming to ANSI B16.39. Pipe threads shall conform to ANSI B2.1.
- D. Flanged fittings shall be rated at 175 psi conforming to ANSI B16.42 (iron) or B16.24 (bronze). Bolts shall be provided with bolt insulators. For pressure above 175 psi the contractor shall provide 250 psi flanges to match piping material, a di-electric gasket and bolt insulators.
- E. Fittings shall be certified to withstand a minimum of 600 volts on a dry line with no flashover.
- F. Di-electric Waterways: 1 inch through 8 inches sizes, plain end, or threaded end, ASTM A-53 carbon steel or ASTM A-536 ductile iron body, zinc electroplated, with LTHS high temperature stabilized polyolefin polymer polymer liner rated to 300 psi meeting ASTM-F-492-77. Fitting shall be Victaulic Style 47 or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply as applicable with verification of existing conditions before starting work.
- B. Verify excavations are to required grade, and not over-excavated.
- C. Verify trenches are ready to receive piping.

3.2 WORKMANSHIP

- A. All work shall be performed by workmen skilled in the trade required for the work. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer and the best practices of the trade and in conformance with the contract documents. The contractor shall promptly notify the Engineer in writing of any conflict between and requirements of the contract documents and manufacturer's directions and shall obtain written instructions from the Engineer before proceeding with the work. Should the contractor perform any work that does not comply with the manufacturer's directions or such written instruction from the Engineer, he shall bear all costs arising in correction such deficiencies.
- B. Prepare piping connections to equipment with flanges or unions. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.3 PIPING – GENERAL

- A. All piping above ground shall be run parallel with the lines of the building. Pipes shall be cut accurately and shall be worked into place without springing, bending, or forcing. Proper allowances shall be made for expansion and contraction of pipes by means of expansion loops or as specified expansion joints and fittings. Pipe openings shall be closed with caps or plugs during storage and installation.
- B. All hydronic pipes inside the building shall be properly graded to drain to a low point where the systems can be emptied. No portions of the piping systems shall trap water which cannot be drained. Drains shall be installed at all low points. All drains shall consist of a ball valve with hose end nipple and end cap with chain.
- C. All changes in size of pipe shall be made by reducing fittings or reduced sockets. Bushing shall not be provided.
- D. Due to the small scale of the drawings, all offset and changes of direction may not be shown. Contractor shall provide necessary offsets and changes of direction to maintain headroom, keep passageways and access openings clear, clear all structural features of the building, piping, ductwork, conduit, equipment, doors, windows and other work as required at no additional cost to the owner. Coordinate with other trades to verify spaces in which work will be installed, and maintain maximum headroom and space conditions at all points.
- E. Piping shall be installed to permit removal without damage to other parts of coils, heat exchangers, fans shafts and wheels, belt guards, sheaves and drives, and other parts requiring periodic replacement or maintenance. Unions or flanges shall be provided at all connections to equipment and wherever their presence will facilitate the easy removal of equipment. Arrange pipes, ducts and equipment to permit

ready access to valves, cocks, traps, starters, motors, dampers, control components, and to clear the openings of swinging and overhead doors and access panels.

- F. Provide proper provision for expansion and contraction in all portions of pipework to prevent undue strains on piping apparatus connected therewith. Provide double swings at riser transfers and other offsets wherever possible, to take up expansion. Arrange riser branches to take up motion of riser. Refer to Section 23 05 16.
- G. Where piping is noted to be valved off for future use or otherwise, the valve shall include an end cap.
- H. Group piping whenever practical at a common elevation and to maintain required headroom wherever two or more pipes are to be installed in parallel, or parallel to the piping of other trades, the piping shall be installed with sufficient space between pipes to allow for the proper application of pipe covering, painting and servicing.
- I. Work installed without coordinating with other work so as to cause interference with other work shall be corrected at installer's expense.
- J. All appliances and equipment shall be installed and connected in accordance with the manufacturer's instructions and recommendations. All piping, valves, connections and other like items recommended by the manufacturer or as required for proper operation are to be provided.
- K. Piping shall not be installed such that it is supported on or suspended from another pipe, electrical conduit, ductwork, or equipment.
- L. Piping shall not be permanently closed up, furred in, or covered over before it has been tested and inspected. All openings in the pipes, drains, fittings, apparatus, and equipment shall be carefully covered or plugged during erection and construction period to prevent accumulating obstructions for the piping.
- M. Water piping shall be pitched up in the direction of flow and be free of traps, air binding, noise, water, hammer and unnecessary bends. The piping shall be graded and valved to provide for complete drainage and control.
- N. Install all horizontal liquid carrying systems to permit air venting at all high points. Provide air vent valves at all high points of systems, at each coil in each piece of equipment and at all up-fed radiation and unit heaters. All air vent valves shall be accessible. Where space permits, air vent valves shall be installed on top of air chambers fabricated of 3/4 inch pipe or tubing approximately 6 to 9 inches long. Vent valves shall be as specified.
- O. Condensate piping for rooftop HVAC equipment shall run to nearest roof drain. Provide roof supports and pitch piping to roof drain.
- P. The following pipe systems unless otherwise shown, shall not pitch less than shown on the following schedule:

Heating Water Lines	1 inch in 50 feet
Air Conditioning & Condensate Drains	1 inch in 8 feet

- Q. All piping which must pass to within six (6) feet, measured horizontally, from all switchboards, panels, metering assemblies, buss ducts, etc., shall be provided with watertight sheet-metal enclosures to completely protect such equipment in the event of leakage. Provide a drain tapping at the low point of the enclosure and pipe such to the nearest drain.

3.4 INSTALLATION – ABOVE GROUND PIPING

- A. Clean all steel pipe erection. Loosen and remove all internal scale from each length of black steel pipe three inches in diameter and larger by supporting the pipe on each end and hammering the entire length; smaller pipe shall be wire brushed inside. Ream all pipe ends after cutting. For screwed joints, apply graphite and oil pipe thread compound to male threads only. Caulking and packing of threads is prohibited. For welded joints, the pipe ends shall be machine beveled wherever possible; leaks at welds shall be repaired by chipping out all weld metal before re-welding and weld metal shall not project within the pipe. Caulking and peeling of welds is prohibited.
- B. For solder joints, clean and ream ends of all copper tubing before jointing and soldering.
- C. Provide 1/2 inch drain ball valves at all low points to drain system. Run drains to floor drains where possible. Where floor drains are not within the area, provide drain valve with a hose nipple as specified.
- D. Install exposed pipe lines parallel with building walls or structure. Do not embed piping in block or concrete wall, nor install where there is a possibility of freezing.
- E. Pipes shall be cut accurately and shall be worked into place without springing or forcing.
- F. Mitering of pipe to form elbows or notching of straight runs to form tees shall not be permitted. Branches connected to main piping may be provided with standard shaped nipples, weldolets or threadolet fittings such that standard piping tees are not available and branch size is a minimum of 2 pipe sizes smaller than main.
- G. Electric welding machine grounding conductors shall be connected in a manner that will prevent welding current flow through any steam equipment that contains electronics (such as a steam meter or pressure transmitter), to prevent damage to the equipment's electronics during installation.
- H. All water risers shall have isolation ball valves and ball valves with hose end with cap and chain at base of riser for drainage, and vent valves at high points. Each piece of equipment shall be valved for isolation from the system and each system shall be valved for total isolation.
- I. All pipe shall be installed to permit complete drainage. Pipe 4 inches and larger in equipment rooms shall have ball drain valves with hose connections and cap with chain at low points.
- J. Dirt pockets shall be provided at the ends of all coils, etc. Dirt pockets at main ends shall be the same size as the end of the main up to 3 inches and not less than 3 inches for larger pipes. Dirt pockets for coil, etc. shall be a minimum of the return outlet connections in the equipment. Dirt pockets shall not be less than 8 inches deep and the ends shall be provided with case brass screwed caps.
- K. Condensate drains shall be installed with a trap and the pan and drain pipe shall be pitched to drain

completely.

- L. Provide drain piping from pump glands, relief valves, coil drain pans and like items to spill over floor drains.
- M. Street elbows, bushings, and long screw fittings will not be allowed. All changes in the pipe sizes shall be made with reducing fittings, reducers or increasers. Only long radius elbows shall be used.
- N. Connections between copper and steel piping shall be made with dielectric unions.
- O. Provide a union ahead of each control valve, steam trap, strainer, and on each side of each piece of equipment and where ever needed to dismantle piping.
- P. Provide expansion devices, pipe loops and cold springing together with anchors and guides so that piping can move noiselessly in response to temperature changes. Piping shall be free expand or contract without injury to equipment or building.
- Q. Escutcheons shall be provided where pipes are exposed in occupied spaces of the building and run through the walls, floors, or ceilings. Escutcheons shall be chrome plated spun brass of plain pattern, and to be set tight on the pipe and to the building surface.
- R. Where sensitive control elements and/or thermometer wells are installed in any piping system, the piping shall be enlarged as required by the cross sectional area of wells. Pipe sizes to be such as not to cause a restriction in the piping where said wells, or sensitive control elements are installed.
- S. When the suction or discharge of any pump unit is smaller than the connecting pipe size, reducing fittings shall be provided at the pump connection only. All strainers, valves, flexible connections, expansion joints, shall be same size as the pipe.
- T. Threaded steel pipe shall be cleanly cut with pipe cutter and burrs removed in the ends by reaming or scraper file.
 - 1. Threads shall be cut with new clean dies, the full thickness of the die.
 - 2. Joints shall have not more than two threads exposed.
 - 3. Threads shall have applied high quality approved red lead and boiled linseed oil, or approved pipe dope, carefully and smoothly placed on the pipe and not on the fittings.
 - 4. Nipples shall be of the same material as the pipe. Close nipples shall not be provided.
- U. Copper tubing shall have the tubing cut off square with tube cutter and all burrs removed with a file or scraper.
 - 1. Outside end of the tubing shall be thoroughly cleaned, slightly longer than the depth of the fitting, to a bright finish. Similarly, the inside of the fitting where the tubing is to be inserted shall be thoroughly cleaned to a bright finish. Sandpaper shall be used for cleaning.
 - 2. Connection to valves in copper tubing shall be made using wrought brass sweat or flanged adapters. Flanged adapters shall be used for butterfly valves 4 inches and larger.
 - 3. All tubing and fittings shall be installed in accordance with the manufacturer's instructions. All solder shall be 95/5, lead free.

- V. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 00.
- W. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors.
- X. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- Y. Install the following items:
 - 1. Valves in accordance with Section 23 05 23.

3.5 REFRIGERANT PIPING SYSTEMS

- A. Provide all refrigerant piping (liquid and suction), solenoid valves, refrigerant distribution manifolds, thermal expansion devices, check valves, etc. All refrigerant lines shall be assembled by brazing under a nitrogen purge using Handy and Harman Sil-Fos consisting of 15% silver, 80% copper, and 5% phosphorous having 1185°F. melting point and 1300°F. flow temperature. Refrigerant piping and accessories shall be arranged, sized, installed, and tested in accordance with the manufacturer's recommendations and as scheduled and detailed in the drawings.
- B. Piping shall be arranged so as to assure positive return of lubricating oil. Any separators, traps, or other devices necessary to accomplish this shall be furnished and installed without additional cost.
- C. When all piping is completed, the Contractor shall evacuate, nitrogen purge, and charge the systems with refrigerant. After start-up add additional refrigerant and lubricating oil to the systems to bring the system up to the levels as recommended by the manufacturer. Once charged, test each entire system with a halogen leak detector. Change the filter dryer elements after system has operated 100 hours.
- D. Condensate drain lines to be Type 'L' copper tubing unless otherwise indicated. Furnish and install 45° fittings and a cleanout at all changes of direction in the condensate drain lines. Provide a "P" trap and cleanout in the condensate drain line from each air handling unit and extend and spill the condensate drain piping as indicated on the drawings.
- E. Refrigerant liquid and suction piping shall be Type 'L' copper tubing as specified under Section 23 05 03.
- F. Insulate refrigerant liquid and suction piping and the air conditioning condensate drain piping as specified under Section 23 07 00.

3.6 WELDING

- A. All welding shall be performed by the shielded metallic arc method fusion welding in accordance with the latest issue of ANSI Code for Pressure Piping, and in accordance with the recommendations of the American Welding Society. All butt welded joints 4 inches in size and larger shall have backing rings. Welding rod shall be of proper type and diameter for the joint being worked. Hot rods will not be permitted. All welds shall be thoroughly cleaned of slag by a wire brush or use of a light pneumatic scaling hammer. Excessive crowning of the bead or deep ripples of undercutting will not be permitted.
- B. Before any welding is performed, the Contractor shall submit to the Engineer a copy of his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section

IX of the ASME Boiler and Pressure Vessel Code. Before any welder performs any welding, the Contractor shall submit to the Engineer a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of the ASME Boiler and Pressure Vessel Code.

- C. Pipe welding and the attachment of weldolets and threadolets shall comply with the provisions of the latest revision of the ASME Code for Pressure Piping. ANSI/ASME B31.9 – Building Service Piping.
- D. Each welder engaged to work shall be certified as having passed qualification tests prescribed by the National Certified Pipe Welding Bureau or other reputable laboratory or agency.
- E. Contractor shall request a Hot Works Permit prior to performing any welding operation. The request must be submitted by the Project Manager the Owner. Contractor shall provide protection of adjacent surfaces, ventilation requirements and system fire alarm shutdown and fire watch. Fume controls shall be provided in occupied buildings.

3.7 INSTALLATION – HEATING PIPING SYSTEMS

- A. Install heating hot water piping in accordance with ASME B31.1 and ASME B31.9.

3.8 SLEEVES

- A. All pipes passing through building concrete and masonry construction shall be fitted with sleeves. Where pipes pass through existing concrete or masonry construction, provide a cement grout between the sleeve and opening. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise required or specified in Part 2. Refer to Section 23 05 29.
- B. For uncovered pipe, sleeves shall be two sizes larger than the pipe except for 6 inch pipe and above, sleeves shall be one size larger. When pipes are covered, the sleeves shall be large enough to allow for the covering and caulking without binding.
- C. Space between all sleeves and passing insulated pipe shall be firestopped with intumescent wrap strip with space between wrap strip and sleeve caulked with firestop sealant. The space between all sleeves and passing metal pipe shall be fire stopped with non-combustible mineral wool and firestop sealant.
- D. Firestop materials shall be UL listed Dow Corning fire stop foam 2001, Firestop Sealant 2000, Firestop Intumescent wrap strip 2002 or equivalent products. Installation shall be in accord with manufacturer's instructions to achieve appropriate fire rating. Fire rating of sealed penetration shall be equivalent to fire rating of assembly being penetrated.
- E. Where pipes pass through waterproofed floors or walls, design of sleeves shall be such that waterproofing can be flashed around and into the sleeves (See Part 2).

3.9 FLOOR, WALL AND CEILING PLATES

- A. Where a pipe passes into a finished space or room there shall be provided a solid or hinged pattern, chrome plated steel, malleable iron or brass, floor, wall or ceiling plate. These plates shall be securely held to the pipe by the set screws. Where sleeves are carried above finished floor, special floor plates shall be installed to provide complete coverage of sleeves and tight fit at floor line.

3.10 PIPING CONNECTIONS

- A. Screwed joints shall be assembled with the lubricant applied on the male threads only.
- B. Soldered joints for the assembly of copper tubing lines shall be made with an approved flux and Englehard Silvabrite 100 lead free solder. The surfaces of the tubing and fittings to be soldered shall be abrasively cleaned and the tubing shall be inserted into the fittings to it full depth. After the joint has been made, all excess flux and solder shall be wiped off.

3.11 FIELD QUALITY CONTROL

- A. Comply as applicable with field inspecting, testing, adjusting, and balancing requirements.
- B. Test heating water piping system, glycol piping system, and chilled water piping system in accordance with ASME B31.9 and ASME B31.1.
- C. Test low pressure steam supply piping, low pressure steam condensate piping, medium and high pressure steam supply piping and medium and high pressure steam condensate piping in accordance with ASME B31.9 and ASME B31.1.
- D. Pressure test fuel oil piping in accordance with NFPA 31.

3.12 CLEANING

- A. Comply as applicable with Execution and Closeout Requirements for cleaning.
- B. After completion, fill, clean and treat heating hot water piping system. Refer to Section 23 25 00.
- C. After completion, clean, and treat low pressure steam supply piping, low pressure steam condensate piping, medium and high pressure steam supply piping and medium and high pressure steam condensate piping.

3.13 MANUFACTURER'S FIELD SERVICES

- A. Comply as applicable with requirements for manufacturer's field services.
- B. Furnish factory trained representative of system supplier for 8 hours of on-site time during leak detection and location system sensor and electronics installation.
- C. Furnish factory trained representative of system supplier for 8 hours of on-site time during final checkout of leak detection and location system.

END OF SECTION 23 05 03

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SECTION 23 05 23 – GENERAL-DUTY VALVES FOR HVAC PIPING

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SECTION 23 05 23 – GENERAL DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ball valves.
- B. Related Sections:
 - 1. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product and installation requirements for pipe hangers and supports.
 - 3. Section 23 07 00 - HVAC Insulation: Product and installation requirements for insulation for valves.
 - 4. Section 23 21 16 - Hydronic Piping Specialties: Product and installation requirements for piping specialties used in hydronic piping systems.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
 - 2. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 3. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.
- B. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 67 - Butterfly Valves.
 - 2. MSS SP 70 - Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 3. MSS SP 71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 4. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 5. MSS SP 80 - Bronze Gate, Globe, Angle and Check Valves.
 - 6. MSS SP 85 - Cast Iron Globe & Angle Valves, Flanged and Threaded.
 - 7. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- C. Underwriters Laboratories Inc.:
 - 1. UL 842 - Valves for Flammable Fluids.

1.4 SUBMITTALS

- A. Comply as applicable with requirements for submittals.
- B. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 SUBSTITUTIONS

- A. Comply as applicable with product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.6 CLOSEOUT SUBMITTALS

- A. Comply as applicable with requirements for submittals.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with State, City, Highways, University's standard.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years' experience.
- B. Installer: Company specializing in performing work of this section with minimum five years' experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with requirements for transporting, handling, storing, and protecting products.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Comply as applicable with environmental conditions affecting products on site.
- B. Do not install valves underground when bedding is wet or frozen.

1.12 WARRANTY

- A. Comply as applicable with requirements for warranties.
- B. Furnish one year manufacturer warranty for valves excluding packing.

1.13 EXTRA MATERIALS

- A. Comply as applicable with requirements for extra materials.
- B. Furnish two packing kits for each size valve.

PART 2 PRODUCTS

2.1 VALVES – GENERAL

- A. All valves used for shut-off purposes on heating hot water services shall be ball valves or butterfly valves as specified hereinafter. Valves on all services used for balancing shall be of balancing and throttling fitting type as specified in Section 23 21 16. Valves shall have pressure ratings (psi) as indicated or as required to meet system operating pressures.
- B. Provide shut-off valves at each piece of equipment so that such equipment can be isolated for repairs while the system is in operation, at all sub-mains and branch mains so that the piping can be isolated for repair while system is in operation, and as shown on the construction documents. Valves installed above 8'-0" in mechanical rooms, shall be provided with chain operators. Bottom of chain shall be 7'-0" above finished floor. Provide balancing fittings at the return side of all equipment and sub-mains at locations as shown on drawings and as required to balance the systems. Provide check valves, as specified hereinafter, in pump discharge lines, where specified in the contract documents, and as required. Triple duty valves shall not be provided.
- C. Viega Propress Pressure Fitting System valves, strainers and other piping specialties shall comply with the valve schedule and shall be permitted.

2.2 VALVE SCHEDULE

Valves shall be as indicated in schedules as follows:

HYDRONIC SYSTEMS - HEATING HOT WATER (40°F THROUGH 210°F) 2" AND SMALLER											
SERVICE	VALVE TYPE	RATING	BODY & BONNET	BALL & STEM	SEAT & PACKING SEALS	LATCH-LOCK LEVER & NUT	DISC HOLDER	DISC	PACKING	BRAND	MODEL OR FIGURE NO.
SHUTOFF	THREADED OR SOLDER ENDS BALL	600 PSI CWP, 150 PSI STEAM	2-PIECE, BRONZE	316 SS EXTENDED STEM & BALL	RPTFE	STAINLESS STEEL	N/A	N/A	N/A	APOLLO VALVES	77C-140 or 240 (SIZE)-04-10-27 A SERIES
SHUTOFF - GAUGE & INSTRUMENT ISOLATION	THREADED OR SOLDER ENDS BALL	600 PSI CWP, 150 PSI STEAM	2-PIECE, BRONZE	316 SS EXTENDED STEM & BALL	RPTFE	STAINLESS STEEL	N/A	N/A	N/A	APOLLO VALVES	77C-140 or 240 (SIZE)-04-10-27 A SERIES
SHUTOFF	PRESS END BALL	250 PSI CWP	2-PIECE, BRONZE	316 SS EXTENDED STEM & BALL	RPTFE	STAINLESS STEEL	N/A	N/A	N/A	APOLLO VALVES	77W-140(SIZE)-10-50 SERIES
SHUTOFF - GAUGE & INSTRUMENT ISOLATION	PRESS END BALL	250 PSI CWP	2-PIECE, BRONZE	316 SS EXTENDED STEM & BALL	RPTFE	STAINLESS STEEL	N/A	N/A	N/A	APOLLO VALVES	77W-140(SIZE)-10-50 SERIES
LOW POINT DRAIN & HIGH POINT VENT	THREADED OR SOLDER ENDS BALL	600 PSI CWP, 150 PSI STEAM	2-PIECE, BRONZE	316 SS EXTENDED STEM & BALL	RPTFE	STAINLESS STEEL	N/A	N/A	N/A	APOLLO VALVES	70-140 or 240 (SIZE)-04-27-HC SERIES
LOW POINT DRAIN & HIGH POINT VENT	PRESS END BALL	250 PSI CWP	2-PIECE, BRONZE	316 SS EXTENDED STEM & BALL	RPTFE	STAINLESS STEEL	N/A	N/A	N/A	APOLLO VALVES	77W-140(SIZE)-04-10-HC SERIES
BALANCING	THREADED OR SOLDER ENDS MANUAL BALANCING	300 PSI	AMETAL	AMETAL	EPDM	N/A	HANDWHEEL	AMETAL	N/A	VICTAULIC TOUR & ANDERSON	TA/IMI SERIES 78K, SERIES 786, SERIES 787

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply as applicable with Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify piping system is ready for valve installation.

3.2 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping and at equipment. Provide drain valves at base of vertical piping risers sized at 1/3 piping riser size.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access where valves and fittings are not accessible.

- F. Refer to Section 23 05 29 for pipe hangers.
- G. Refer to Section 23 07 00 for insulation requirements for valves.
- H. Refer to Section 23 05 03 for piping materials applying to various system types.
- I. Install Work in accordance with the authority having jurisdiction.

3.3 VALVE APPLICATIONS

- A. Install shutoff and drain valves at locations indicated on Drawings and in accordance with this Section.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers. Provide valves at branches, branch mains and sub mains.
- C. Install ball or butterfly valves in heating water systems for shut-off service.
- D. Install balancing fitting valves in water systems for throttling service.

END OF SECTION 23 05 23

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SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Formed steel channel.
 - 7. Firestopping relating to HVAC work.
 - 8. Firestopping accessories.
- B. Related Sections:
 - 1. Section 03 10 00 - Concrete Forming and Accessories: Execution requirements for placement of inserts and sleeves in concrete forms specified by this section.
 - 2. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
 - 3. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
 - 4. Section 07 90 05 - Joint Protection: Product requirements for sealant materials for placement by this section.
 - 5. Section 09 90 00 - Painting and Coating: Product and execution requirements for painting specified by this section.
 - 6. Section 23 05 00 – Common Work Results for HVAC: Flashing and firestopping.
 - 7. Section 23 34 00 – HVAC Fan Ventilators and Accessories: Roof curbs.
 - 8. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 - Power Piping.
 - 2. ASME B31.5 - Refrigeration Piping.

- 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
 - 1. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 2. ASTM E814 - Standard Test Method for Fire Tests of Through Penetration Fire Stops.
 - 3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH - Certification Listings.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 FIRESTOPPING SYSTEM DESCRIPTION

- A. Firestopping Materials: To achieve fire ratings of adjacent construction in accordance with FM Global requirements and UL Design Numbers noted on Drawings.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Comply as applicable with Submittal Procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit sizing methods and calculations sealed by a registered professional engineer. Design and responsibility for hanger design and selection rests with the Mechanical Contractor. Provide design services of a Professional Engineer for piping hangers, incidental structural supports and steel frames and floor supported equipment.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.8 SUBSTITUTIONS

- A. Comply as applicable with Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.9 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations within Wall Cavities: T-Rating is not required.
- B. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- C. Fire Resistant Joints between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- D. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- E. Perform Work in accordance with applicable authority and AWS D1.1 for welding hanger and support attachments to building structure.
- F. Perform Work in accordance with State, City, University's standard.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.11 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.13 ENVIRONMENTAL REQUIREMENTS

- A. Comply as applicable with Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.14 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.15 WARRANTY

- A. Comply as applicable with Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for pipe hangers and supports.

1.16 GENERAL

- A. For poured concrete floor and roof decks, provide approved box type inserts for all piping, ductwork and equipment hangers. Continuous inserts may be used where 2 or more parallel lines of piping are installed. Where required to distribute the load on the inserts, a piece of reinforcing steel three feet long shall be passed through the insert. Maintain the inserts in place during construction. Inserts shall be sized per manufacturer's recommendations on a factor of safety of 5 and be UL and FM approved.
- B. Where concrete inserts have been omitted due to failure of Contractor to set same, or in existing, concrete, self-drilling concrete anchors or power driven studs or pins may be used, provided approval is obtained from the Design Professional. Operators of power driven equipment must have Pennsylvania Department of Labor and Industry certificate indicating that they have obtained operating instructions in the make and model of power driven tools used on this project. Anchors, pins and studs shall be selected per recommendations of the representative manufacturer for safe carrying loads.
- C. Pipes, ductwork and equipment shall be suspended from building structural steel or from auxiliary steel provided by this Contractor by means of beam or channel clamps, bolting or welding and shall be selected per manufacturer's recommendations for safe carrying loads.
- D. Clips may be welded to underside of metal decking provided method of attachment is approved by the Design Professional.
- E. Provide all supports, including angles, channels and platforms for the support of all equipment installed under this contract. Indicated types and model numbers are representative and do not indicate all types and models that maybe required for a complete and proper installation.
- F. Provide additional hangers and supports for heavy valves, specialties and heavy weight piping.
- G. All piping and equipment shall be rigidly and firmly installed to prevent swaying, vibrating and sagging

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers
 - 1. Anvil International.
 - 2. Carpenter & Patterson.
 - 3. National Pipe Hanger.
- B. Model numbers are based on Anvil to establish type and quality unless otherwise noted. Friction type support hangers shall not be provided.
- C. Clevis Hangers
 - 1. For non-insulated copper piping 2 inches and smaller provide figure CT-65. Hanger shall be carbon steel with copper plated finish.
 - 2. For insulated copper piping 2 inches and smaller provide Figure 260. Hanger shall be carbon steel with plain finish. Maximum temperature for plain finish shall not exceed 650 degrees F.
- D. Roller Hangers and Supports
 - 1. Provide roller hangers and supports for hot water glycol and vent piping subject to expansion beyond clevis hanger capabilities and prevent binding.
 - 2. Roller hangers shall be Figure 181 with cast iron roll, carbon steel yoke, roll rod, hex nuts and plain finish. Maximum temperature at roller shall not exceed 450 degrees F.
 - 3. Roller supports shall be as follows:
 - a. Adjustable pipe roll support shall be Figure 177 with cast iron roll and sockets, steel roll rod, continuous threaded rods, hex nut and plain finish.
 - b. Roller chair shall be Figure 175 with cast iron roll, steel chair, roll rod, bolts, hex nuts and plain finish.
 - c. Pipe roll and base plate shall be Figure 277 with cast iron roll, cast iron stand, and plain finish.
 - d. Pipe roll stand shall be Figure 271 with cast iron roll, cast iron stand, and plain finish.
 - e. Adjustable pipe roll stand shall be Figure 274 with cast iron roll, cast iron stand, steel base plate, steel adjusting screws and plain finish. Provide Figure 275 without base plate.
 - f. Maximum temperature at roller shall not exceed 450 degrees F.
- E. Pipe shields and saddles:

- Where piping is specified hereinafter to be insulated, all insulated piping shall be provided with thermal pipe shields as manufactured by Pipe Shields Incorporated. Provide type A2000 (A4000 for pipe span over 10 feet and A6000 for use on pipe roller) shall be used for chilled and dual temperature water piping and type A1000 (A3000 for pipe span over 10 feet and A5000 for use on pipe roller) shall be used for the steam condensate and hot water piping. Shields shall consist of a 360 degree insert of high density 100 psi, waterproof calcium silicate, encased in a 360 degree sheet metal shield. Provide vapor barrier sealant joints and install per manufacturer's written instructions. Insert shall be same thickness as adjoining pipe insulation. Shield length and minimum shield metal gauges as listed below. For larger sizes and roller application refer to manufacturer recommendations. Insulation insert to extend 1 inch beyond sheet metal shield on all shields.

Pipe Size	Shield Length	Minimum Gauge
1/2" to 1-1/2"	6"	24
2" to 6"	6"	20

F. Accessories:

- Riser clamps shall be Figure 261, Figure 40, Figure 103, or as required to meet project requirements. Clamps shall be carbon steel with plain finish. Maximum temperature shall not exceed 650 degrees F for plain finish.
- Pipe clamps shall be Figure 103, Figure 295, or as required, to meet project requirements. Clamps shall be carbon steel with plain finish. Maximum temperature shall not exceed 650 degrees F for plain and finish.
- Trapeze hangers shall be Figure 45 or Figure 46. Hangers shall be carbon steel with plain finish.
- "U" bolts shall be Figure 137 complete with hex nuts. Bolts and nuts shall be carbon steel with plain finish.
- Beam clamp shall be as follows:
 - Figure 86 with Figure 89 retaining clip. Clamp shall include set screw and lock nut. Clamp shall be malleable iron with harden steel cup point set screw and ribbed design. Retaining clip shall be carbon steel. Assembly shall be plain finish.
 - Figure 13 and/or 218.
- Brackets shall be Figure 194, Figure 195 or Figure 199 to meet project requirements. Brackets shall be carbon steel with plain finish.
- Threaded rod shall be Figure 146. Rod shall be carbon steel with threads full length of rod and plain finish.
- Pipe stanchion shall be Figure 63 Type A, B, C, P, T to meet project requirements. Stanchion shall be carbon steel plain finish. Maximum temperature at pipe connections shall not exceed 650 degrees F for plain finish. Base plate shall be provided with bolt holes as required.
- Adjustable pipe saddle support shall be Figure 264. Support shall have cast iron saddle, locknut nipple and cast iron reducer assembled with plain finish.

2.2 INSERTS, ANCHORS AND STUDS

- A. Manufacturers
 - 1. Anvil International.
 - 2. Carpenter & Patterson.
 - 3. National Pipe Hanger Corp.
- B. Model numbers are based on Anvil to establish type and quality unless otherwise noted.
- C. Inserts into concrete slabs shall be Figure 281, carbon steel body with malleable iron nut and galvanized finish.
- D. Metal deck hangers shall be Figure 284 with welded carbon steel arms and bolt assembly and plain finish.
- E. Self drilling anchors may be provided upon approval of the Design Professional. Anchors shall be Phillips Red Head Series "S" or "F" or approved equal.
- F. Power driven studs or pins may be provided upon approval of the Design Professional. Studs or pins shall be Hilti fastening system or approved equal.

2.3 ROOF MOUNTED EQUIPMENT PIPE AND DUCT SUPPORTS

- A. Manufacturers
 - 1. Thycurb
 - 2. Pate
 - 3. Roof Products
 - 4. Rooftop Blox
 - 5. MAPA
 - 6. Mifab
- B. Model numbers are based on Thycurb to establish type and quality unless otherwise noted.
- C. Prefabricated equipment mounting supports to be prime galvanized steel construction, 18 or 14 gauge as required, meeting ASTM A-446, 525, 526 and 527, with welded corners and 3" can't fully mitered where applicable with seams joined by continuous welds. Supports shall be internally reinforced with bulkheads and spreaders 24" on center, have factory installed 2x4 or 2x6 wood nailer and 18 ga. counterflashing.

Certified load bearing data shall be provided. Height to be 8" above roof deck or as detailed. Equipment supports shall span a minimum of two (2) joists and not cantilever more than 12". Support shall be level at the top with pitch built-in when deck slopes 1/4 of an inch per foot or greater, or as detailed.

Equipment pipe and duct mounting supports shall be TEMS-1, TEMS-2, or TEMS-3 Fabricating Division of ThyBar Corporation.
- D. At the option of the contractor and with the approval of the Engineer roof mounted duct and piping supports shall be a pre-molded UV resistant polypropylene copolymer with a foam base platform of 1 inch thick 25 pound density closed cell polystyrene, recycled rubber, fiberglass reinforced nylon or 304 stainless steel. Base shall be securely fasten to roof by bolts or adhesive. Provide support rods or channels, rollers, hangers, clamps, and accessories to support indicated items.

- E. Supports shall be designed and installed to prevent sway, and to meet anticipated wind forces to meet project requirements.
- F. Supports shall be installed per manufacturer's installation instructions and to requirements of the roofing type.
- G. Supports shall not be installed atop of debris or roof ballast. Supports shall rest on clean roofing material or attach to building structural steel.

2.4 PIPE PENETRATION CURBS AND COVERS

- A. Pipe penetration roof curbs shall be 12" high, fully constructed of 18 gauge G-90 galvanized steel with fully welded and mitered corners with wood nailer 2x2 fasted to top.
- B. Counterflashing cover to be ABS Thermoplastic Korad Acrylic with multiple sealed outlets to received graduated boots molded weather resistant Platisol and (2) stainless steel clamps for each outlet. ThyCurb Models TCC-1 has (1) 12" diameter boot to accommodate pipes 6" to 10, TCC-3 has (2) 3-1/2" and (1) 6-1/2" diameter boors for pipes 1/2" to 5" and TCC-5 has (5) 3-1/2" boots for 1/2" to 2-1/2" pipes.
- C. Curbs and covers shall be manufactured by ThyBar Corporation of Addison, IL.

2.5 SLEEVES AND LINTELS

- A. Lintels where required shall be identified by the Mechanical Contractor and shall be provided by the General Contractor of size and capacity to meet project requirements.
- B. Pipes and conduits passing through new and existing masonry or concrete footing walls, floors, and masonry walls and partitions shall be provided with sleeves made form Schedule 40 steel pipe securely and neatly cemented in place.
- C. Unless otherwise indicated, pipe, conduit, or EMT sleeves shall be Schedule 40 steel pipe and shall be (2) pipe sizes larger than any pipe, conduit, or EMT to remain uninsulated. Where pipes are to be covered, the sleeves shall be large enough to allow the covering to pass through the sleeves with clearance. All sleeves shall be securely and neatly cemented in place. Sleeves through floors shall extend one inch above the finished floor line.
- D. Unless otherwise indicated, duct sleeves shall be 16 gauge sheet metal securely fastened in place.
- E. Pipes, conduit, EMT, and/or ductwork passing through frame or metal partitions shall be provided with sleeves made from No. 18 gauge galvanized sheet metal securely fastened in place.
- F. In fire rated and all other locations, caulk the space between the wall assembly or sleeve and conduit, EMT, pipe (uninsulated and insulated) or duct with UL approved firestop product to obtain a UL listed fire rated assembly. All products shall be installed in strict compliance with the manufacturer's instructions. Use applicable sealants for the temperatures of the systems protected.
- G. Contractor shall set and be responsible for the proper locations, alignment, etc. of sleeves.
- H. All sleeve packing shall be installed so as not to interfere with expansion and contraction of piping.

- I. Lintels, where required, shall be identified to the Contractor during the bidding phase. The Contractor will provide all lintels.

2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers
 - 1. Thunderline Link-Seal, Inc.
 - 2. Metraflex
 - 3. Calpico
- B. Model numbers are based on Thunderline Link Seal to establish type and quality unless otherwise noted.
- C. Provide where indicated on the drawings, where piping penetrates outside walls and where piping penetrates wall below grade, "a" modular mechanical seal consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the piping and the wall opening. The elastomeric element shall be sized, selected and installed per manufacturer's recommendations.
 - 1. Provide Model CS HDPE thermoplastic wall sleeve for poured in place wall construction. Sleeve shall have molded-in water stop and reinforcing ribs to anchor sleeve in the wall. Provide nailer end caps.
 - 2. Provide Model WS heavy wall steel wall sleeve for poured in place wall construction. Sleeve shall be welded or seamless pipe with full circle water stop plate to act as a water seal and anchor to reduce thrust movement. The collar shall be continuously welded on both sides. Sleeve shall have galvanized finish.
 - 3. For piping with surface temperatures ranging from minus 40 degrees F to plus 250 degrees F provide Model "C" with EDPM seal element composite pressure plate and steel/zinc dichromate nuts and bolts.
 - 4. For piping with surface temperatures ranging from minus 67 degrees F to plus 450 degrees F provide Model "T" with silicone seal element and steel/zinc dichromate pressure plates, nuts and bolts.
 - 5. For piping penetrating fire rated construction provide Model FD/FS with silicone seal element, steel/zinc dichromate pressure plates, nuts and bolts.
 - 6. For piping provided with insulation provide insulation shield and saddles as specified in Paragraph 2.1 E so that the seal does not come in direct contact with insulation, or provide secondary pipe sleeve around insulation. Shield and saddle shall be around entire pipe circumference.
- D. Seal shall be designed to withstand hydrostatic pressures up to 20 psig (40 feed head) and provide protection from galvanic corrosion and electrolysis.
- E. Where the annular opening is larger than the expanded thickness of a single seal assembly, provide a second layer of seal assembly with an intermediate sleeve between seal assembly layers.
- F. When pressure testing of pressure build-up behind the seal is desired provide one link with a hole molded to accept a test probe. The probe shall be provided with a MPT female connection inserted prior to tightening the assembly. The probe shall be firmly sealed by expansion of the link. A pressure gauge shall be attached to monitor pressure build-up.

2.7 FORMED STEEL CHANNEL

- A. Manufacturers
 - 1. Unistrut Corp.
 - 2. B-Line Systems
 - 3. Allied Tube & Conduit Corp.
- B. Furnish materials in accordance with State, City, and University standards.
- C. Channel shall be 12 gage thick galvanized steel with holes 1-1/2 inches on center. Channel shall be provided with all accessories required to hang or support items to meet project requirements.

2.8 FIRESTOPPING

- A. Manufacturers
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products
 - 6. Specified Technology, Inc.
- B. Furnish materials in accordance with the standards of the authority having jurisdiction.
- C. Coordinate with Firestopping section.
- D. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: [Single] component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: [Single] [Multiple] component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- E. Color: As selected from manufacturer's full range of colors.

2.9 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products [or products tested by independent testing laboratory].
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply as applicable with Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Obtain permission from Design Professional before using powder-actuated anchors.
- E. Obtain permission from Design Professional before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.

- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69 or MSS SP 89.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every other floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 23 07 00 – HVAC Insulation.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members, formed steel channel, steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 23 05 47 - Vibration Controls for HVAC Piping and Equipment.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors [1] inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.7 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Place intumescent coating in sufficient coats to achieve rating required.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where ductwork, piping, conduits, and wiring penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons, floor plates, or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal all pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.8 FIELD QUALITY CONTROL

- A. Comply as applicable with Section 01 40 00 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.9 CLEANING

- A. Comply as applicable with Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK

- A. Comply as applicable with Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.11 SCHEDULES

- A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2 (Note 1)	9	11	1/2	1/2
3	10	12	1/2	1/2
4	12	14	1/2	5/8

Note 1: Data for steel piping is based on standard weight piping. Adjust rod size and hanger spacing for extra strong piping.

Note 2: All hanger clamps in contact with copper tubing shall be as specified above except hangers shall be copper plated or copper; rod and support shall be steel.

END OF SECTION 23 05 29

SECTION 230548 – VIBRATION CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this section.

1.2 WORK INCLUDED

- A. Provide complete vibration control systems as shown or specified and in accordance with the requirements of the Contract Documents. Systems shall be complete with foundations, vibration isolation, and supports for rigidly supported equipment.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Consult all other Sections to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner. This work includes, but is not limited to the following:
 - 1. Fans
 - 2. Air Handling Equipment
 - 3. Ductwork
 - 4. Duct Insulation (External)
 - 5. Internal (Acoustical) Duct Insulation
 - 6. Pumps
 - 7. Piping
 - 8. Plumbing Fixtures
 - 9. Heating and Cooling Equipment
 - 10. Concrete Housekeeping Pads
 - 11. Noise Control for Mechanical Systems
 - 12. Noise and Vibration Control for Electrical Systems

1.4 CONTRACTOR'S RESPONSIBILITY

- A. Verify the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.
- B. Furnish and install seismic, wind, fire, and flood resistance for all components specified in this Section in accordance with the requirements of the relevant portions of the applicable building code (IBC 2006).

- C. Performance or waiving of inspection, testing, or surveillance for any portion of the work shall not relieve the Contractor of the responsibility to conform strictly with the Contract Documents.
- D. In the event of a conflict between two or more requirements of this specification, submit a written Request for Clarification prior to furnishing or installing any equipment or systems.

1.5 MANUFACTURER'S RESPONSIBILITIES

- A. Manufacturer of vibration isolation equipment shall have the following responsibilities:
 - 1. Provide vibration isolation systems as scheduled and specified.
 - 2. Guarantee specified isolation system deflection.
 - 3. Provide installation instructions, drawings, and field supervision to ensure proper installation and performance.
 - 4. Determine all mounting sizes.
 - 5. Ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Provide additional support structure where required.
 - 6. Design seismic, wind, fire, and flood resistance for all components specified in this Section in accordance with the requirements of the relevant portions of the applicable building code.

1.6 BID PROPOSALS

- A. Submit at the time of bidding the names and qualifications of the vibration control supplier(s). If a supplier is not one of the pre-approved vendors, then the submittal shall be accompanied by a complete catalog of that supplier's products and samples of each proposed vibration isolator.

1.7 SUBMITTALS

- A. Submit fully coordinated shop drawings for all vibration control equipment. These submittals shall state the acoustical performance of the products as described below.
- B. Isolators: submittal shall include drawings prepared by the isolation system manufacturer showing the construction of the isolation devices to be used, including project specific isolator selection.
 - 1. Submit vibration isolation system schedule indicating the following:
 - a. Manufacturer, type, model number, size
 - b. Height when uncompressed and static deflection of each isolation element
 - c. Spring constant of each isolation element
 - d. Estimated imposed load on each isolation element
 - e. Spring o.d., free operating, and solid heights
 - f. Design of supplementary bases
 - g. Seismic restraints, including attachment calculations by the Seismic Restraint Manufacturer's licensed Engineer substantiating the seismic restraints are furnished and installed in accordance with IBC 2006 and local building codes. A registered professional engineer having a PE from the same state as the project, or state of restraint manufacturer shall stamp all analyses, or as required by codes.

- h. Layout of isolator hangers, mounts, and other elements shown on an outline of the isolated equipment, including complete details of attachment to load-bearing structure or supplementary framing
- i. Piping isolators shown and identified on piping layout drawings, including a riser diagram for isolated shaft piping.
- j. Furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of vibration isolation equipment. Include drawings of all required seismic, wind, fire, and flood resistance. All concrete foundations and supports (and required reinforcing and forms) will be furnished and installed by another trade.

1.8 QUALITY ASSURANCE

- A. It is the objective of this specification to control vibration due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork, or conduit.
- B. The installation of all vibration control systems shall be under the supervision of a manufacturer's representative.
- C. All vibration isolation and seismic, wind, fire, and flood resistance equipment and materials shall be provided by a single manufacturer. The following manufacturers are approved provided systems are in compliance with the specified design and performance requirements:
 - 1. Mason Industries, Inc., Hauppauge, New York
 - 2. Kinetics Noise Control, Dublin, Ohio
 - 3. The VMC Group, Bloomington, NJ

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment provided for vibration isolation shall be new and manufactured specifically for the purpose intended.

2.2 VIBRATION ISOLATION SYSTEMS

A. GENERAL

- 1. The static deflection of isolators shall be as given in the equipment schedule and specified below. The Vibration Isolation Schedule at the end of this section shall take precedence.
- 2. All vibration isolators shall be selected in accordance with IBC-2006, and all local building codes related to seismic, wind, fire, and flood requirements.
- 3. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.
- 4. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, static deflection may be verified.

5. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50 percent above the design deflection.
6. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ± 10 percent.
7. All elastomeric mountings shall have Shore hardnesses of 30 to 60 ± 5 , or as specified herein, after minimum aging of 20 days or corresponding over-aging.
8. Unless otherwise specified, steel spring isolation systems as described in the specifications shall utilize bare (unhoused) springs with the spring diameter not less than 80 percent of the loaded operating height of the spring. Each spring isolator shall be designed so that the ends of the spring remain parallel during and after the spring installation. All isolators shall operate in the linear portion of their load versus deflection curve and have 50 percent excess capacity without becoming coil bound.
9. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings shall be provided with a powder coat finish. Springs shall be powder coated and shall have a minimum 1000-hour rating when tested in accordance with ASTM-B-117. Nuts and bolts shall be cadmium plated.

B. FLEXIBLE DUCT CONNECTORS

1. Flexible sleeves for duct connections shall be fabricated from flexible, airtight, flame-retardant fabrics, coating, and adhesives complying with UL Standard 181 Class 1.
2. Extra-Wide Metal-Edged connectors: Factory-fabricated with a strip of fabric 6 in. wide attached to 2 strips of 3 in. wide, 24-gauge galvanized sheet steel or 0.032-gauge aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition 2005, Figure 2-17.
 - a. Fabric: Glass fabric double coated with neoprene.
 - 1) Minimum Weight: 26 oz. per square yard
 - 2) Minimum Tensile Strength: 480 lb. per inch in the wrap and 360 lb. per inch in the filling.
3. Flexible duct connectors shall be Durodyne "Neoprene", or equal.

C. VIBRATION ISOLATION GROMMETS

1. Vibration isolation grommets shall be elastomeric sleeves used to isolate hold-down bolts from equipment bases.
2. Mason model HG, or as approved.

D. FLEXIBLE PIPE CONNECTORS

1. Flexible pipe connectors shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Higher rated connectors may be used to accommodate service conditions. All connections must be factory tested to 150 percent of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1. Concentric reducers to the above ratings may be

substituted for equal ended flexible connections. Control rods shall not be used. Flexible pipe connections shall be type SAFEFLEX SFEJ as manufactured by Mason Industries, Inc.

2. Where system pressure or contaminants dictate their use instead of EPDM flexible pipe connections, flexible metal hoses shall be used to isolate equipment from piping. Flexible metal hoses shall have stainless steel braid and carbon steel fittings. Sizes 3 in. (75mm) and larger shall be flanged. Smaller sizes shall have male nipples. Metal hoses length shall be a minimum of ten times the nominal pipe diameter. Hoses shall be installed on the equipment side of the shut off valves horizontally and parallel to the equipment shafts wherever possible. Flexible metal hoses shall be Mason type BSS or approved equal.

E. THRUST RESTRAINTS

1. Thrust restraints shall consist of a spring in series with an elastomeric pad. Restraint assembly shall be designed so it can be field adjusted to allow for a maximum of 3/8 inch movement at equipment start and stop. Restraint assembly shall be designed to sustain an overload force equal to 5 times the design force without failure. Attachment hardware is considered part of the restraint assembly if it is required for installation.
2. Thrust restraints shall be Mason Industries type WB or approved equal.

F. ELASTOMERIC RISER GUIDE

1. Riser guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2 in. (12mm) thickness of 60 durometer elastomeric material. Guides shall accommodate a minimum of 1-5/8 inches of vertical pipe motion in either direction.
2. Riser guides shall be Mason type VSG or approved equal.

G. ISOLATOR TYPE PAM

1. Type PAM (pipe anchor mounts) shall consist of two sizes of steel tubing separated by a minimum of 1/2 inch thick, 60 durometer or less elastomeric material. Vertical restraint shall be provided by the same material arranged to prevent up or down vertical travel. Allowable loads shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
2. Acoustical pipe anchor mountings shall be Type ADA by Mason Industries, Inc., or as approved.

H. ISOLATOR TYPE WP

1. Type WP (Waffle Pads) shall be 5/16 in. thick elastomeric pads ribbed or waffled on both sides. The pads shall be manufactured with bridge bearing quality elastomeric material and selected for a maximum durometer of 50 and designed for 15 percent strain. Where required, steel load spreading plates shall be incorporated between the equipment and the elastomeric pad.
2. For equipment bolted to the structure, a vibration isolation grommet shall be installed under the bolt head between the steel washer and the base plate.
3. Mason Industries type W, or equal.

I. ISOLATOR TYPE MWP

1. Type MWP (Metal and Waffle Sandwich Pads) shall consist of two 5/16 in. thick ribbed or waffle elastomeric pads sandwiching a 16-gauge stainless steel shim plate. The pad shall be manufactured with bridge bearing quality elastomeric material and selected for a maximum durometer of 50 and designed for 15 percent strain.

2. For equipment bolted to the structure, a vibration isolation grommet shall be installed under the bolt head between the steel washer and the base plate.
3. Mason Industries type WSW, or equal.

J. ISOLATOR TYPE SWP

1. Type SWP shall be a 3/4 in. thick waffle elastomeric pad manufactured with bridge bearing quality elastomeric material.
2. For equipment bolted to the structure, a vibration isolation grommet shall be installed under the bolt head between the steel washer and the base plate.
3. Mason Industries model Super W, or equal.

K. ISOLATOR TYPE DDNM

1. Type DDNM (Double Deflection Elastomer Mounts) shall be laterally stable, double deflecting, molded elastomeric isolators. All metal surfaces shall be covered with elastomeric material. The top and bottom surfaces shall be ribbed, and bolt holes shall be provided in the base. The mounts shall have levelled bolts rigidly secured to the equipment.
2. The isolator shall be manufactured with bridge bearing quality elastomeric material and selected for a maximum durometer of 50 and designed for 15 percent strain. DDNM mounts shall be selected for a static deflection of 3/8 in. unless otherwise specified.
3. Mason Industries type ND, or equal.

L. ISOLATOR TYPE DDNH

1. Type DDNH (Double Deflection Elastomer Hangers) shall consist of a molded elastomeric isolating element in a steel hanger box. An elastomeric sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 in. larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30-degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degree without encountering any obstructions.
2. The isolator shall be manufactured with bridge bearing quality elastomer and selected for a maximum durometer of 50 and designed for 15 percent strain.
3. Mason Industries type HD, or equal.

M. ISOLATOR TYPE BR

1. The mount shall consist of a ductile iron casting containing two separated and opposing molded elastomeric elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. Mount shall have a minimum static deflection of 0.2 in. and all directional seismic capability.
2. Mason Industries Type BR or equal.

N. ISOLATOR TYPE SPNM

1. Type SPNM (Spring and Elastomer Mounts) shall have a free standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80 percent of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50 percent of the specified static deflection.

2. Isolator mounts shall be installed complete with 1/4 in. thick elastomeric pad between the isolator base plate and the supporting structure.
3. Mason Industries Type SLF, or equal.

O. ISOLATOR TYPE SPNH

1. Type SPNH (Spring and Elastomer Hangers) shall consist of a steel spring in series with an elastomeric isolating element. The spring shall have a minimum additional travel to solid equal to 50 percent of the specified deflection. The elastomeric element shall have a static deflection of not less than 0.3 in. with a strain not exceeding 15 percent.
2. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30-degree arc. An elastomeric sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 in. larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360-degree arc without encountering any obstructions.
3. Mason Industries Type 30N, or equal.

P. ISOLATOR TYPE CSNM

1. Type CSNM (Constrained Spring and Elastomer Mounts) shall be a housed spring and elastomeric mount that incorporates springs with built-in leveling device. CSNM mount shall incorporate resilient vertical restraints to prevent spring elongation when partial load is removed or when the unit is subjected to wind loading. Restraining bolts shall have an elastomeric bushing between the bolt and the housing. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position mounts shall contain an internal elastomeric isolation pad.
2. A minimum clearance of 1 in. shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring operation. Limit stops shall provide minimum 1/4 in. clearance under normal operation, and an elastomeric washer shall be installed beneath the bolt head/ washer used to restrain the isolator.
3. Provide minimum 1/4 in. thick elastomeric acoustical base pad on underside of mount.
4. Mount shall be capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
5. Mason Industries Type SLR, or equal.

Q. BASE TYPE CIB

1. Inertia base Type CIB (Concrete Inertia Base) shall have an integral rectangular structural steel form into which concrete is poured.
2. Perimeter members shall be beams of depth equal to 10 percent of the longest span of the base, but not more than 12 in. nor less than 6 in. deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
3. When the concrete base is T-shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.
4. The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.
5. Each inertia base (rectangular or "T" shape) shall include supports and base elbows for any suction and discharge connections to pumps. Base elbows shall be bolted and grouted to the inertia base.

6. Concrete inertia base shall be provided with a 2 in. minimum operating clearance between the base and housekeeping pads. The concrete inertia base shall be at least 6 inches wider than the pump frame.
7. Concrete inertia bases with a smaller plan dimension greater than 40 inches shall be constructed with an air relief opening near the center.
8. Base shall be Mason Industries Type BMK or K, or equal.

R. BASE TYPE CMB

1. Base Type CMB (Curb Mounted Base) for roof mounted equipment shall be a structural steel base mounted directly to the structure with an upper floating section on adjustable steel springs. The upper frame shall provide continuous support for the equipment. Steel springs shall rest on 1/4 in. minimum thickness elastomeric pads. All directional elastomeric snubber bushings shall be minimum 1/4 in. thickness. All hardware shall be plated, and the springs provided with a rust resistant finish.
2. Weatherproofing shall consist of a continuous galvanized flexible counterflashing nailed over the lower curb's waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers to allow for adjustment or replacement of springs. Lower curbs shall have provision for 2 in. insulation.
3. Duct connections shall be made using a length of flexible duct dimensioned to match the equipment opening, using an elastomeric gasket to seal against the unit bottom.
4. The floating member of the roof curb shall have perimeter angle and cross members to support two layers of 5/8 in. thick waterproof sheetrock laid on with staggered joints. Sheetrock shall surround duct penetrations completely and shall be caulked at all seems and intersections. A four-inch-thick layer of 1.5 pcf density fiberglass shall cover the entire solid roof surface under the unit. Complete instructions shall be provided by manufacturer.
5. Curb shall be Mason Industries Type RSC or equal.

S. BASE TYPE SCMB

1. Base type SCMB shall consist of an extruded aluminum top member that overlaps the bottom member to provide water runoff independent of the airtight seal. Aluminum members shall house electro-galvanized, or powder coated springs selected for static deflection as given in the vibration isolation schedule at the end of this section. Travel to solid shall be 1.5 in. minimum. Spring diameters shall be no less than 0.8 of the spring heights at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 0.25 in. so as not to interfere with the spring action except in high winds. Manufacturer's self-adhering closed cell sponge gasketing shall be used both above and below the base and a flexible EPDM connection shall seal the outside perimeter. Foam or other sliding or shear seals are not acceptable.
2. Curb shall be Mason Industries Type CMAB or equal.

T. BASE TYPE SB

1. Base type SB shall be a structural steel rectangular base with cross members where the longest beam dimension exceeds 6 feet, to prevent twisting.
2. Structural steel shall have a depth equal to 10 percent of the longest span between mounting locations, but not more than 12 in. nor less than 4 in. deep.
3. Use height-saving brackets in all mounting locations.

PART 3 - EXECUTION

3.1 GENERAL

- A. All rotating or reciprocating equipment shall be mounted on or suspended from vibration isolators as specified herein or as shown on the drawings. Where a discrepancy between the drawings and this specification exists, the specification shall govern.
- B. All rotating or reciprocating mechanical equipment not specifically identified in this specification shall be installed on elastomeric isolators. Floor mounted equipment shall be mounted on Type DDNM, and ceiling mounted equipment shall be hung from Type DDNH isolators.
- C. All rotating or reciprocating equipment mounted on vibration isolators shall be installed in accordance with the relevant requirements of IBC-2006 with respect to seismic, wind, fire, and flood resistance.
- D. All floor-mounted equipment shall be erected on 4 in. thick concrete housekeeping pads over the complete floor area of the equipment. These pads shall be integrally keyed to structural slab. Wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be in turn mounted on concrete housekeeping pads unless otherwise specified.
- E. Furnish and install vibration isolation grommets for hold down bolts to prevent any metal-to-metal contact.
- F. Piping, ductwork, conduit, or mechanical equipment shall be supported from building structure, not hung from, or supported on other equipment, pipes, or ductwork.
- G. Vibration isolated equipment connected to water or other fluid piping shall be erected at correct operating heights prior to connection of piping. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of temporary blocking and shims.
- H. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated from natural rubber.
- I. Install all springs such that the ends of springs remain parallel. All springs installed with adjustment bolts.
- J. Vibration isolators shall be selected to be non-resonant with equipment forcing frequencies or supporting structure natural frequencies.
- K. Refer to Vibration Isolation Schedule at the end of this Section for specific vibration isolation requirements.

3.2 FAN ISOLATION

A. GENERAL

- 1. Fans and air handling units shall be leveled with the fans operating before the flexible connectors are attached.
- 2. Thrust restraints shall be installed on all fan heads, ceiling suspended fans, and air-handling equipment operating at 2 in. of water or more total static pressure. Thrust restraints shall

incorporate the same static deflection as the unit isolators (as given in the Vibration Isolation Schedule at the end of this section). Install thrust restrains as near as possible to the centerline of thrust.

3. Drain pipes for air handling units shall be supported only from the isolated air handling unit frame. The condensate shall drip into a funnel that is supported from the floor or floor drain. A gap of at least 2 in. shall be maintained between the end of the air handling unit drain pipe and funnel or floor drain.

B. SUSPENDED FANS

1. Fans suspended from overhead structure shall be hung on vibration isolators as given in the Vibration Isolation Schedule at the end of this section.
2. Fans shall be suspended from above only if expressly noted as such on the drawings and schedules.

3.3 PUMP ISOLATION

A. GENERAL

1. Flexible pipe connectors shall be installed on both sides of each pump between the pump and the inlet and discharge piping. Inlet and discharge piping shall be aligned with the pump prior to installation of flexible pipe connectors. Flexible pipe connectors shall not be used to correct equipment offsets. Flexible pipe connectors shall not support any of the vertical load of the pump or associated piping.

B. MOUNTING OF CENTRIFUGAL PUMPS – (3 HP OR GREATER)

1. Each pump with its driving motor shall be bolted and grouted to a vibration isolated reinforced concrete inertia base. Inertia bases shall be supported on vibration isolators as given in the Vibration Isolation Schedule at the end of this section.
2. Concrete inertia base minimum thickness shall be in accordance with the following schedule:

<u>Motor Size</u>	<u>Thickness Required</u>
3 ≤ HP < 15	6 in.
15 ≤ HP < 50	8 in.
50 ≤ HP	12 in.

3.4 VIBRATION ISOLATION OF MECHANICAL SYSTEM PIPING

A. GENERAL

1. The following piping connected to vibration isolated HVAC equipment shall be isolated:
 - a. All piping within equipment rooms
 - b. Piping outside of equipment rooms within 50 feet or 100 pipe diameters of connected rotating equipment, whichever is greater
 - c. All piping greater than 2-inch diameter in shafts if the piping enters the shaft within the distances specified above.
 - d. All piping where exposed on roof.

2. Where supplementary steel is required to support piping, the supplementary steel shall be sized so that maximum deflection between supports does not exceed 0.08 inches. Supplementary steel shall be supported from the building structure with vibration isolation mountings and hangers as described below. Piping shall be rigidly attached to the supplementary steel.
3. Where isolated piping 8 in. and larger is supported directly below exposed steel beams, attachment to the beam shall be made by means of welded channel beam attachments located directly under the web of the beam. For piping 6 in. and smaller beam clamps may be used in lieu of welding subject to approval of beam clamp selection.

B. PIPES CONNECTED TO EQUIPMENT ON SPRING ISOLATORS

1. All pipes connected to equipment installed on spring vibration isolators, except sprinkler piping, shall be suspended on or supported by Type SPNH or Type SPNM isolators. Provide vibration isolation anchors and guides as specified elsewhere in this specification
 - a. Provide precompressed type isolators for all piping greater than 6 inches in diameter and all supplementary steel supports. The precompression shall be factory set at 75 percent of rated deflection.
2. The first three isolators both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 1 inch.

C. PIPES CONNECTED TO EQUIPMENT ON ELASTOMERIC ISOLATORS

1. Piping that is connected to machinery installed on elastomeric isolators only shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDNH hangers.

D. PIPES WITH MULTIPLE CONNECTIONS

1. Where a pipe run connects multiple items of equipment in the mechanical room of the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

E. FLEXIBLE PIPING CONNECTORS

1. Flexible pipe connectors shall be installed to connect piping diameter 2 in. or greater to reciprocating or rotating equipment.
2. Install flexible piping connectors on the equipment side of the shut-off valve.

F. PIPING IN SHAFTS

1. Pipe riser guides, anchors, and supports including piping anchors in mechanical equipment rooms or occupied spaces shall be isolated from the building structure such that there shall be no direct metal to metal contact of the piping with the building structure.
2. Piping in shafts requiring vibration isolation per the requirements of section 3.8.A.1 above shall be attached to the building structure through type PAM isolators, elastomeric riser guides, and resilient supports.
3. The pipe riser clamp at anchor points, shall be welded to the pipe and to pairs of type PAM mounts which in turn, shall be rigidly fastened to steel framing in the pipe shaft.

4. Where pipes rise in a vertical chase and require lateral bracing, elastomeric riser guides shall be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.
5. Piping isolation supports at the base of risers shall be type MWP isolators. Suitable bearing plates sized to provide a pad loading of 500 psi maximum shall be provided. The stanchion between the pipe and isolation support shall be welded to the pipe and welded or bolted to the isolation support. The isolation support shall be bolted to the floor slab with vibration isolation grommets.

G. PRESSURE REDUCING VALVES

1. Pressure reducing valves and associated piping shall be suspended by or supported on Type DDNH or Type DDNM isolators for the lengths specified in section 3.8.A.1 above.

H. CONDENSER WATER PIPING

1. Isolate all condenser water piping running inside the building between cooling towers and pumps with Type SPNH isolators for all suspended piping and Type CSNM for floor or roof supported piping. All condenser water piping isolators shall have a nominal static deflection of 1 inch.

3.5 DUCT VIBRATION ISOLATION

- A. Ducts shall be connected to fans, fan casings and fan plenums by means of flexible duct connectors. Flexible connectors shall be installed to prevent metal-to-metal contact across flexible connection. Flexible duct connectors shall not be used otherwise unless expressly shown on the drawings.

3.6 WIRING

- A. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with flexible conduit having sufficient slack so as not to impede movement of equipment on isolators. This Contractor shall coordinate wiring connections with the Electrical Contractor.

3.7 FIELD QUALITY

- A. Contractor shall work in accordance with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first-class quality.

3.8 ADJUSTMENT AND TESTING

A. SITE ACCESS

1. During installation of equipment, Contractor shall arrange for access as necessary for inspection of vibration isolation control equipment by Architect and his representatives.

B. CONTRACTOR'S REPORT

1. The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Owner that verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

C. CONSULTANT'S OBSERVATION

1. Notify the Architect in writing upon completing installation and adjustment for suitable operation of all work specified under this section. The letter shall certify that all work specified under this section is complete, operational, and adjusted in every respect, and that all work is ready for the completion checkout. The notification letter shall be accompanied by a copy of the air balancing report and the vibration isolation report.
2. Upon notification of completion, Architect will schedule an observation by the Acoustics Consultant, who will measure the background noise level with all Mechanical Systems running.
3. For each inspection, Contractor shall perform such functions as are necessary for inspection of the equipment. Background noise level testing may be carried out during late-night hours when ambient noise from outside is at a minimum and the site is otherwise not occupied, and no work is under way. Contractor shall turn on and off any and all mechanical equipment during such background noise level testing.

3.9 GUARANTEE

- A. If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

VIBRATION ISOLATION SCHEDULE FOR MECHANICAL EQUIPMENT

EQUIPMENT	EQUIPMENT TAG	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION
Boiler			DDNM	0.4 in.
Roof-Mounted AHU's (or IF CURB MOUNTED)		- CMB	CSNM -	2 in. 2 in.
Roof-Mounted Mushroom Fans			SCMB	1 in.
Rooftop Evaporator			SCMB	1 in.
Rooftop Condenser			SCMB	1 in.
Base-mounted pumps (3 hp or greater)		CIB	SPNM	2 in.
Base-mounted pumps (less than 3 hp)			DDNM	.4 in.
VAV Boxes			SPNH	1 in.
Piping			Isolation per specification.	
Ducts			Isolation per specification.	

END OF SECTION 230548

SECTION 230549 - NOISE CONTROL FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this section.

1.2 WORK INCLUDED

- A. Provide complete noise control systems as shown or specified and in accordance with the requirements of the Contract Documents. System shall be complete with:
 - 1. Duct Silencers
 - 2. Fan and Duct System Plenums
 - 3. Sealing Around Penetrations Through Walls and Slabs

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Consult all other Section to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner. This work includes, but is not limited to the following:
 - 1. Fans
 - 2. Ductwork
 - 3. Duct Insulation (External)
 - 4. Internal (Acoustical) Duct Insulation
 - 5. Pumps
 - 6. Chillers
 - 7. Piping
 - 8. Plumbing Fixtures
 - 9. Heating and Cooling Equipment
 - 10. Concrete Housekeeping Pads
 - 11. Vibration Control for Mechanical Systems
 - 12. Noise and Vibration Control for Electrical Systems

13. Sealant

1.4 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall be responsible for verifying the completeness of the installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.
- B. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly with the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

1.5 MANUFACTURER'S RESPONSIBILITIES

- A. Manufacturer of noise and control systems shall have the following responsibilities:
 - 1. Provide piping and equipment isolation systems as scheduled or specified.
 - 2. Provide installation instructions, drawings and field supervision to assure proper installation and performance.

1.6 BID PROPOSALS

- A. The Contractor shall submit at the time of bidding the names and qualifications of the noise control equipment supplier(s). If a supplier is not one of the pre-approved vendors, then the submittal shall be accompanied by a complete catalog of that supplier's products and samples of each proposed vibration isolator.
- B. Contractor shall submit at the time of bidding the design sound power level of each air moving device (including fans and package air handlers) as described in the Contract Documents. If the actual sound power generated by any device exceeds in any octave band the specified sound power levels for the equipment specified in the Contract Documents, the contractor shall include in his price system modifications as required to compensate for the additional noise at no expense to the Owner. Any such system modification shall be subject to review and approval.

- C. If the standard sizes of silencers offered by the silencer supplier do not provide attenuation equal to or greater than the insertion loss specified in the schedule in each octave band 1 through 6, then at the time of bidding the supplier shall note all such discrepancies and propose how to make up the difference within the bid quote. The controlling requirements are the insertion loss, pressure drop and self-noise.

1.7 SUBMITTALS

- A. Contractor shall submit fully coordinated shop drawings for all noise control equipment. These submittals shall state the acoustical performance of the products as described below.
- B. Sheet Metal: Coordinated shop drawings at $\frac{1}{4}$ in. = 1 ft. -0 in. minimum scale shall be submitted for review and approval to indicate the following:
 - 1. Length, width, height, and elevation of bottom of each duct segment.
 - 2. Sheet metal gauge
 - 3. Location of duct silencers, fire dampers, and balancing dampers.
 - 4. Transition segments marked with entrance and exit sizes, as well as length and elevation. Markings should indicate which sides are held level, and which ones slope.
 - 5. If a duct segment is offset in the horizontal or vertical direction, this information must be noted.
 - 6. Duct lining thickness.
 - 7. Any restraints or points of conflict due to existing conditions or planned piping, conduit, structure, or finish which will interfere with the installation of the ductwork.
- C. Air moving devices (Supply, return and exhaust fans, package AHU's): Submit sound power levels in octave bands from 63 Hz through 8000 Hz inclusive for the operating conditions specified. Data shall be obtained in accordance with AMCA 300-85. If fans are variable speed, provide sound power level data for maximum rpm and also at 80 percent and 60 percent of maximum rpm. Provide discharge, inlet and case-radiated sound power data for all fans.
- D. Submit for each fan a performance curve showing the operating point for which the acoustical data has been provided.
- E. Cooling Towers: Submit sound pressure levels in octave bands from 63 Hz to 8000 Hz inclusive measured at 5 ft. and 50 ft. in 4 cardinal directions and vertically above the top of the unit. Data shall be obtained in accordance with ANSI 12.34-1988.
- F. Silencers: Submit test data from an independent laboratory showing the insertion loss and air-flow-regenerated noise of the specified silencers in octave bands from 63 Hz to 8000 Hz, measured in accordance with ASTM E477-73. Pressure drop ratings shall be measured for the same silencer tested for acoustical performance; the data shall be submitted with the acoustical performance data. The insertion loss of the silencers shall be measured and reported in octave band or 1/3-octave bands.

- G. Acoustical Louvers: Submit test data from an independent laboratory showing the insertion loss and air-flow-regenerated noise of the specified louvers in octave bands from 63 Hz to 8000 Hz, measured in accordance with ASTM E477-73. Pressure drop ratings shall be measured for the same louver tested for acoustical performance; the data shall be submitted with the acoustical performance data. The insertion loss of the louvers shall be measured and reported in octave band or 1/3-octave bands. Submittal shall include assembly drawings and details of joints and fittings to be used in the installation.
- H. Prefabricated Plenum Panels: Submit test data from an independent accredited laboratory indicating sound transmission loss performance of panel system in accordance with ASTM-E90 and sound absorption performance of panels, vision ports and access doors in accordance with ASTM C423. Submittal shall include assembly drawings and details of joints and fittings to be used in the installation.
- I. Grilles and diffusers, variable air volume boxes and dual conduit boxes: Submit shop drawings complete with sound power levels generated by each terminal device at the air flow and pressure drop specified in the contract documents.

1.8 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

<u>Space</u>	<u>RC Levels</u>
Glee Club Rehearsal Room	25
Glee Club Sectionals	30
Concert Band Rehearsal Room	15
Spirit Band Room	35
Control Room	25
Office	35
Corridors	40
Mechanical and Electrical Rooms	45
Sound, Communications, and AV Equipment Rooms	45

- B. Penetrations by ducts, pipes and conduit between noise critical spaces shall be sleeved, packed and sealed airtight with non-hardening sealant as described herein.

1.9 QUALITY ASSURANCE

- A. It is the objective of this Specification to provide for the control of noise due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork or conduit.
- B. The installation of all noise control systems shall be under the supervision of the manufacturer's representative.
- C. All prefabricated duct silencers shall be furnished by a single manufacturer with a minimum five years experience. The following manufacturers are approved provided equipment is in compliance with the specified design and performance requirements:
 - 1. Industrial Acoustics Company, Bronx, New York
 - 2. Vibron
 - 3. Vibro-Acoustics
 - 4. United Sheet Metal
 - 5. Price Industries
 - 6. Semco
- D. All prefabricated acoustical plenums shall be furnished by a single manufacturer with a minimum five years experience. The following manufacturers are approved, provided equipment is in compliance with the specified design and performance requirements:
 - 1. Industrial Acoustics
 - 2. Kinetics
 - 3. Vibro-Acoustics
 - 4. United Sheet Metal
 - 5. Price Industries
 - 6. Semco
- E. The following duct liner manufacturers are approved, provided the product is in compliance with the specified design and performance requirements:
 - 1. Certainteed
 - 2. Owens-Corning
 - 3. Knauf
 - 4. Johns-Manville

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment provided for noise control shall be new and manufactured specifically for the purpose intended.

2.2 INTERNAL ACOUSTICAL DUCT LINING

- A. The liner shall meet the Life Safety Standards as established by NFPA 90A and 90B, FHC 25/50 and Limited Combustibility and the airstream surface coating should contain an immobilized, EPA-registered, anti-microbial agent so it will not support microbial growth as tested in accordance with ASTM G21 and G22. The duct liner shall conform to the requirements of ASTM C 1071, with an NRC not less than .70 as tested per ASTM C 423 using a Type "A" mounting, and a thermal conductivity no higher than 0.25 Btu•in/hr•ft²•°F (0.039 W/m•°C) at 75°F (24°C) mean temperature. Duct liner shall comply with the requirement of NFPA 90A and the "Duct Liner Materials Standard" of the Thermal Insulation Manufacturer's Association. Duct lining shall incorporate means to prevent fiber entrainment in the air stream.
- B. Duct lining shall have minimum density of 3.0 pcf.
- C. Sizes shown on the drawings are free area dimensions (after installation of duct liner)
- D. Acceptable product for lining rectangular section ducts and plenums: Shuller "Permacote Linacoustic" or approved equal.

2.3 FOAM ROD

- A. Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.

2.4 NON-HARDENING SEALANT

- A. Sealant for penetrations shall be non-hardening polysulphide type.
- B. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.

2.5 PACKING MATERIAL FOR PENETRATIONS

- A. Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m³).

2.6 ACOUSTICAL LOUVERS

- A. Outer casing shall be of 16 gauge galvanized steel. Louver baffles shall be of airfoil configuration and be made of 22-gauge galvanized steel. Louvers shall be packed with inter, vermin and moisture proof mineral fiber and provide the acoustical performance as indicated on the Drawings or specified herein. Louvers shall be factory primed for field finish painting.
- B. Static pressure drop shall not exceed 0.25 in. at application design air flow. Manufacturer shall submit certified laboratory test data substantiating both the specific acoustical and aerodynamic performance.
- C. Acoustical Louver shall have the following minimum Transmission Loss (TL) values in dB:

Band	1	2	3	4	5	6	7	8
TL	5	7	11	12	13	14	12	9

- D. Louvers shall be IAC Type R or approved equal.

2.7 FIRE DAMPERS

- A. Fire dampers shall be a type with the blade stored out of the air stream.

2.8 FLEXIBLE DUCT CONNECTORS

- A. Flexible sleeves for duct connections shall be fabricated from flexible, airtight, flame-retarded or noncombustible fabrics, coating, and adhesives complying with UL Standard 181 Class 1.
- B. Extra-Wide Metal-Edged Connectors: Factory-fabricated with a strip of fabric 5-3/4 in. wide attached to 2 strips of 2-3/4 in. wide, 24-gauge galvanized sheet steel or 0.032-gauge aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.

1. Fabric: Glass fabric double coated with polychloroprene.
 - a. Minimum Weight: 26 oz per square yard
 - b. Tensile Strength: 480 lb per inch in the wrap and 360 lb per inch in the filling.

2.9 DUCT SILENCERS

- A. Rectangular duct silencers shall have outer casings of not less than 22-gauge galvanized steel. Seams shall be lock formed and mastic filled. The internal baffles (splitters) shall be not less than 24-gauge galvanized perforated steel having an open area of about 30 percent. The nosings shall be full radius or airfoil shape.
- B. The sound absorbing media shall be not less than 4.5 pcf glass/mineral fiber packed under 5 percent compression. The fiber fill shall be incombustible, mildew resistant and vermin proof. The sound absorbing material shall be protected from erosion.
- C. If the silencer is installed in a location exposed to water or weather, the fill shall be completely encapsulated in Mylar bagging. The Mylar bagging shall not degrade the acoustical performance of the silencer.
- D. If the silencer is supplied in modular sections, the silencer shall meet or exceed the specification for single-module silencers with respect to insertion loss, pressure drop, regenerated noise and air leakage.

2.10 AIR TERMINAL UNITS

- A. Unit manufacturer shall furnish when requested certified sound power levels for both discharged air and casing radiated sound in each of the second through sixth octave bands for every unit furnished with inlet pressures of 3/4 in., 1-1/2 in., and 3 in. w.g. determined in accordance with ASHRAE Standard 36-72, latest publication. Room sound levels (RC or NC) shall be shown for each unit for design CFM and inlet pressures of 3/4 in., 1-1/2 in. and 3 in. w.g. for both discharged air and casing radiated sound power sources. Terminal unit discharge and radiated sound levels shall not cause occupied space sound pressure levels to exceed scheduled levels shown below.
- B. The maximum permissible sound-power levels in octave bands for airborne sound transmission through the combination of grilles, register, diffusers for terminal units, related pressure reducing devices, or fans when operated in installed condition per plans and specifications, shall be as follows:

Octave	Maximum PWL (in dB re: 10 ⁻¹² watts)				
<u>Bands</u>	<u>RC-20</u>	<u>RC-25</u>	<u>RC-30</u>	<u>RC-35</u>	<u>RC-40</u>

1	56	58	60	62	66
2	47	50	53	56	60
3	37	41	45	49	54
4	31	36	41	46	51
5	28	33	38	43	48
6	27	32	37	42	47
7	26	31	36	41	46
8	27	32	37	42	47

- C. The maximum permissible radiated sound power levels in octave bands for all terminal units, related pressure reducing boxes, or fans when operated in installed condition concealed in a ceiling over occupied spaces, shall be as follows:

Octave	Maximum PWL (in dB re 10 ⁻¹² watts)		
<u>Bands</u>	<u>RC-30</u>	<u>RC-35</u>	<u>RC-40</u>
1	68	72	76
2	64	68	72
3	56	61	65
4	54	58	62
5	51	55	60
6	50	54	58
7	55	64	68
8	60	65	70

- D. Boxes are not to be installed concealed in ceilings of spaces requiring less than RC-30 ambient noise levels as scheduled this Section.

2.11 AIR HANDLING UNITS

- A. Units shall be tested by an independent acoustical testing laboratory having NVLAP certification in accordance with AMCA Standard 300-85. The test setup shall be determined to most closely approximate the actual configuration of scheduled equipment.

- B. Total octave band sound power levels from 63 Hz to 8000 Hz from all scheduled fan equipment shall be submitted for review and approval.

- C. Sound power level for specific fan equipment shall not exceed the following (in dB re: 10^{-12} watts):

Octave Band	1	2	3	4	5	6	7	8
Center Freq., Hz	63	125	250	500	1K	2K	4K	8K
RTU-1 Discharge	84	78	81	86	84	79	76	75
RTU-1 Inlet	74	71	77	81	71	68	67	65
RTU-2 Discharge	83	79	85	82	81	77	75	74
RTU-2 Inlet	71	81	78	69	66	65	63	61

2.12 FANS

- A. Units shall be tested by an independent acoustical testing laboratory having NVLAP certification in accordance with AMCA Standard 300-85. The test setup shall be determined to most closely approximate the actual configuration of scheduled equipment.
- B. Octave band sound power levels from 63 Hz to 8000 Hz for radiated, discharge and inlet noise from all scheduled fan equipment shall be submitted for review and approval.

PART 3 - EXECUTION

3.1 GENERAL

- A. Piping, ductwork, conduit or mechanical equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.

3.2 FLEXIBLE DUCT CONNECTORS

- A. Ducts shall be connected to fans, fan casings and fan plenums by means of flexible connectors. Flexible connectors shall be installed to prevent metal-to-metal contact across flexible connection. Flexible duct connectors shall not be used outside the mechanical room unless expressly shown on the drawings.

3.3 DUCT SILENCERS

- A. Duct silencers shall be furnished and installed as shown on the mechanical drawings and as called for in the silencer schedule.
- B. Unless otherwise specified, the insertion loss of the duct silencers shall be not less than the values shown in the silencer schedule.
- C. The pressure drop across the duct silencers shall not exceed the values scheduled on the drawings.
- D. Unless otherwise specified, the self-noise of the duct silencers shall be not more than the following values at an air velocity of 1000 fpm in the direction of sound propagation.

Octave-Band Self-Noise Power Levels in dB at the following frequencies			
Face Area	63 Hz	125 Hz	250 Hz
2 sq. ft.	38	26	30
4 sq. ft.	41	29	33
6 sq. ft.	44	32	36
8 sq. ft.	47	35	39

3.4 DUCTWORK FABRICATION

- A. Fabricate ductwork so as to be free from vibration, rattle or drumming under all operating conditions; provide all materials necessary for specified construction, whether or not they are specifically called for or detailed on the drawings.

3.5 BRACING OF DUCTWORK

- A. Do not install tie rods within ducts serving noise critical spaces.

3.6 ACOUSTICAL LINING OF DUCTS

- A. Ducts, except where noted otherwise, shall be acoustically lined internally, from the air moving device to the terminal. Both supply and return systems shall be lined unless otherwise specified. Exhaust ducts shall be internally lined where shown on the drawings to reduce sound transmission.
- B. Other ductwork shall be acoustically lined where shown on the drawings.

- C. The acoustical liner shall be fixed to the duct with a minimum of 50 percent coverage of a fire-resistant adhesive. Where the duct width exceeds 12 in. or the height 24 in., the liner shall be additionally secured with mechanical fastening on maximum 16 in. centers on all sides. Mechanical fasteners that pierce the duct are unacceptable. All ends of the liner shall be coated with a fire resistant cementing material to prevent delamination, leakage or erosion. All joints shall be firmly butted and ends coated with an adhesive to ensure that the lining is smooth across all joints.
- D. Where acoustical duct lining is installed, the dimensions of the sheet metal shall be increased to include the thickness of the lining material. Dimensions shown on the mechanical drawings are the clear internal dimensions after the liner has been installed.

3.7 SHEET METAL AND PIPING PENETRATIONS OF SHAFTS, FLOOR SLAB AND/OR PARTITIONS

- A. There shall be no direct contact of Sheet Metal or piping with shaft walls, floor slabs and/or partition.
- B. All openings around pipes and ducts in the structure surrounding the mechanical equipment and surrounding noise-critical spaces shall be sealed packed with caulking for the full depth of the penetration, as described herein, and as shown on the drawings. This includes all slab penetrations and penetrations of noise critical walls.

3.8 DUCT PENETRATIONS

- A. Where each duct passes through a wall, floor or ceiling, there shall be a clear annular space of 1 in. between the duct and structure. After all of the ductwork is installed the Contractor shall check the clearance, pack the voids full depth with mineral fiber batt insulation and caulk both ends with a non-aging, non-hardening sealant backed by a polyethylene foam rod or permanently flexible firestop material. Where there is not sufficient access space to pack around all sides of a duct (for example, at the underside of a slab), place a short stub duct in the wall, pack and caulk around it and then attach the inlet and outlet ducts to each end.

3.9 PIPE PENETRATIONS

- A. HVAC, DOMESTIC WATER, SEWER, DRAIN AND VENT PIPING
 - 1. Where a pipe passes through a wall, ceiling or floor slab, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 in. larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within ½ in.. Then the void shall be packed full

depth with glass/mineral fiber and sealed at both ends, 1 in. deep, with sealant backed by foam rod.

B. SPRINKLER PIPES

1. Fire protection and compressed air pipes may be sleeved and sealed as described above, or may be grouted and caulked into the structure as follows: before grout has set, rake a groove around the pipe on each side of the wall or slab; groove shall be ½ in. wide and ½ in. deep. After grout has set, fill groove full depth with sealant.
2. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed as described herein. There shall be no rigid connection between ceiling and pipes or heads.

3.10 DAMPERS

- A. Dampers shall be installed only where shown on the drawings or approved by the acoustics consultant. All variations in damper locations must be approved in writing by the acoustics consultant.

3.11 ELBOWS

- A. All rectangular or round ductwork shall have full radius elbows or except where mitered elbows are shown on the drawings.
- B. Where space limitations prevent the installations of full radius elbows, short radius elbows with a minimum two continuous splitter vanes shall be installed. Vane length shall be the entire length of the bend, or 36 in., whichever is greater. Provide separate equal size sections for greater lengths.

3.12 CONTROLS

- A. Pneumatic thermostats shall not be located in noise critical spaces.
- B. Self-timers for mechanical systems shall not be located in noise critical spaces.

3.13 WIRING

- A. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with flexible conduit having sufficient slack so as not to impede movement of equipment on isolators. This Contractor shall coordinate wiring connections with the Electrical Contractor.

3.14 FIELD QUALITY

- A. Contractor shall work in accord with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first class quality.

3.15 ADJUSTMENT AND TESTING

A. SITE ACCESS

- 1. During installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and his representatives.

B. CONSULTANT'S INSPECTION

- 1. Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify the Architect in writing. The letter shall certify that all work specified under this section is complete, operational and adjusted in every respect, and that all work is ready for the completion checkout. The notification letter shall be accompanied by a copy of the air balancing report and the vibration isolation report.
- 2. Upon notification of completion, Architect will schedule an inspection by the Acoustics Consultant, who will measure the background noise level with all Mechanical Systems running.
- 3. For each inspection, Contractor shall perform such functions as are necessary for inspection of the equipment. Background noise level testing must be carried out during late-night hours when ambient noise from outside is at a minimum and the site is otherwise not occupied and no work is under way. Contractor shall turn on and off any and all mechanical equipment during such background noise level testing.

3.16 GUARANTEE

- A. If, in the actual installation, any equipment fails to meet the noise control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

END OF SECTION – 230549

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SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Ceiling tacks.
 - 6. Lockout devices.
- B. Related Sections:
 - 1. Comply as applicable with Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

- A. Comply as applicable with Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Samples: Submit two [nameplates,] [tags,] [stencils,] [labels,] [pipe markers,] [tacks,] [lockouts,] [and] [lables], size used on project.

- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
 - F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- 1.5 SUBSTITUTIONS
- A. Comply as applicable with Section 01 60 00 – Product Requirements.
 - B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.
- 1.6 CLOSEOUT SUBMITTALS
- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
 - B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.
- 1.7 QUALITY ASSURANCE
- A. Conform to OSHA and ANSI/ASME A13.1 latest edition for color scheme for identification of piping systems and accessories and shall be compatible with the MIMS system.
- 1.8 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
 - B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.
- 1.9 PRE-INSTALLATION MEETINGS
- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
 - B. Convene minimum one week prior to commencing work of this section.
- 1.10 FIELD MEASUREMENTS
- A. Verify field measurements prior to fabrication.
- 1.11 EXTRA MATERIALS
- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
 - B. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 - 1. Seton Identification Products.
 - 2. Brady.
 - 3. Mifab.
- B. Model numbers are based on Seton to establish type and quality unless otherwise noted.

2.2 NAMEPLATES

- A. Provide multi-layer acrylic nameplate with engraved white letters on black contrasting background color. Suitable for indoor and outdoor use Nameplate shall be Style Number M1774, 4 inches by 1-1/2 inches.

2.3 TAGS

- A. Metal Tags:
 - 1. Provide .040 Brass tags with stamped letters. Tag shall be Model M1804 with tag size minimum 1-7/8 inches by 1 inch with finished edges.
- B. Information Tags:
 - 1. Provide clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3 x 5-3/4 inches with grommet and self-locking nylon ties. Tag shall be Style 12587.
- C. Provide type written tag chart of letter size indicating list of applied tags and location. Tag chart shall be in a plastic laminated frame.
- D. Tags shall be securely connected to the specific item with a brass chain or "S" hook.

2.4 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 - 3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 - 4. Ductwork and Equipment: 1-3/4 inches high letters.
- B. Stencils shall be Style Series 4400.
- C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.5 PIPE MARKERS

A. Color and Lettering:

1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with nylon ties or spring fastener. Markers shall be Model Setmark.

B. Plastic Underground Pipe Markers:

1. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service. Marker shall be Model 85522.

2.6 CEILING TACKS

A. Description: Steel with 7/8 inch diameter color-coded head. Tacks shall be Model L2411.

B. Color code as follows:

1. HVAC equipment: Yellow.
2. Fire dampers/smoke dampers: Red.
3. Heating/cooling valves: Blue.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Plated steel hasp with erasable label surface; size minimum 7-1/4 x 3 inches. Hasp shall be or Model 29082.

B. Valve Lockout Devices:

1. Plastic device preventing access to valve operator, accepting lock shackle. Device shall be Model Style L016X.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 90 00.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates or stencil painting. Identify in-line pumps and other small devices with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify valves in main and branch piping with tags.
- I. Identify air terminal units and radiator valves with numbered tags.
- J. Tag automatic controls, instruments, and relays. Key to control schematic.
- K. Identify piping, concealed or exposed, with plastic pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Provide ceiling tacks to locate equipment, valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to item.

END OF SECTION

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SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Scope of the Work - provide the required testing, adjusting, and balancing for the following:
 - 1. Air conditioning equipment including air distribution devices, supply ducts, air handling units, condensing fans, fans, coils, and related equipment associated with the following systems:
 - a. Packaged rooftop unit RTU-1 and RTU-2;
 - b. All VAV terminals associated with rooftop units;
 - c. Existing relocated VAV terminals;
 - d. Existing rooftop AHU-2.
 - 2. All hydronic systems including water distribution systems, coils, and related equipment associated with the following systems:
 - a. Hydronic heating coils;
- B. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Testing, adjusting, and balancing of hydronic and steam systems.
 - 3. Measurement of final operating condition of HVAC systems.
- C. Related Sections:
 - 1. Section 23 05 00 - Common Work Results for HVAC.
 - 2. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment.
 - 3. Section 23 05 23 - General Duty Valves for HVAC Piping.
 - 4. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
 - 5. Section 23 09 00 - HVAC Instrumentation and Controls: Requirements for coordination between DDC system and testing, adjusting, and balancing work.
 - 6. Section 23 21 16 - Hydronic Piping Specialties.
 - 7. Section 23 31 00 - HVAC Ducts and Casings.
 - 8. Section 23 33 00 - Air Duct Accessories.
 - 9. Section 23 34 00 – HVAC Fans, Ventilators and Accessories.
 - 10. Section 23 36 00 - Air Terminal Units.
 - 11. Section 23 37 00 - Air Outlets and Inlets.
 - 12. Section 23 73 00 - Packaged Rooftop Heating and Cooling Units.

1.3 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.4 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 - Submittal Procedures: Submittal procedures.
- B. Submit proof that the Test and Balancing Engineer assigned to supervise the procedures and the technicians who will perform the procedures meet the qualifications of the AABC or NEBB organizations.
- C. Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balancing Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems.
 - 1. Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports shall be provided within three days of each visit noting successful completion of the balancing or noting areas of concern, specific issues that need to be addressed and areas or components that will be balanced. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 - 2. Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit [4] complete sets of final reports.
 - 3. Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary
 - b. Air Systems
 - c. Hydronic Systems
 - d. Temperature Control Systems
 - e. Special Systems
 - 4. Provide the following minimum information, forms and data:

- a. Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name, address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.
- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.5 CLOSEOUT SUBMITTALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of flow measuring stations, balancing valves with rough setting and balancing dampers with rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance ASHRAE 111 and NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- B. Prior to commencing Work, calibrate each instrument to be used. Upon completing Work, recalibrate each instrument to assure reliability.
- C. Review of sheetmetal shop drawings per Section 23 31 00 1.5F.

1.7 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum ten years documented experience certified by AABC or Certified by NEBB.
- B. An independent testing and balancing firm not associated with the Mechanical Contractor under a direct contract with the construction manager shall be responsible for all testing and balancing work.

1.8 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene a minimum of one week prior to commencing work of this section with the Architect/Engineer and/or representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing. The TAB Contractor shall report any system problems, conditions or deficiencies to the Mechanical Contractor for remedy before final testing, balancing and adjusting. The TAB Contractor shall obtain a set of approved shop drawings and a set of the latest design drawings for use in the conference.

1.9 SEQUENCING

- A. Comply as applicable with Section 01 10 00 - Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.
- C. The HVAC Contractor and his selected and approved TAB firm shall report to and review the TAB work required with a representative of the Design Professional prior to beginning of his work. At least two one-day inspections of the water and air systems at appropriate times during construction shall be made by the TAB firm who shall report their findings to a representative of the Design Professional. All openings, pressure taps, wells and closures required over and above those shown on the drawings shall be installed during or after construction at no additional cost to the Owner.
- D. Furnish all services for a minimum of two complete adjustments of water systems and air handling and exhaust systems, water and air distribution and controls, for the first cooling season and for the first heating season after the job is in complete operation under load conditions.

1.10 SCHEDULING

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Schedule and provide assistance in final adjustment and test of life safety smoke evacuation and smoke control systems with Fire Authority.

1.11 SCOPE OF EXCLUSIONS

- A. This section does not include the following:
 - 1. Testing, pressure rated vessels, non-pressure rated vessels, and other equipment for compliance with safety codes or standards.
 - 2. Specifications for materials and installation of adjusting and balancing devices. If devices are required to be added to achieve proper adjusting and balancing, refer to the respective specification sections for material and installation requirements.

1.12 DEFINITIONS

- A. Testing, adjusting and balancing is the process of checking and adjusting all of the systems to produce the design values. This includes the following:
1. Test: To determine quantitative performance of equipment.
 2. Adjust: To regulate the specified fluid flow rate and air pattern at the terminal equipment ie; fan speed, throttling, etc. including pulleys, belts, etc.
 3. Balance: To proportion flows within the distribution systems (mains, submains, branches, terminals, etc.) according to specified design quantities.
 4. Terminal: The point where controlled fluid enters or leaves the distribution system. These include supply inlets and outlets on water equipment, supply inlets and outlets on air equipment, supply, return, and exhaust devices such as grilles, registers, diffusers, hoods, etc.
 5. Main: Duct or pipe containing the system's major or entire fluid flow.
 6. Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.
 7. Branch Main: Duct or pipe serving two or more terminals
 8. Branch: Duct or pipe serving a single terminal.

1.13 CONDITIONS

- A. System shall not be balanced until the HVAC system is complete and in full working order, and all areas of general construction are complete (walls, doors, ceilings).

1.14 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after submission of a completed balancing report, during which time the Owner may request a recheck of no more than 10% of total number of terminals, or resetting of any outlet, coil, or device.
- B. Warranty/Guarantee must meet one of the following programs. TABB International Quality Assurance program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

PART 2 PRODUCTS

2.1 Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. The general, electrical, mechanical, controls, and sheet metal contractor(s) will verify that systems are complete and operable before commencing work. Responsible installing contractors shall ensure the following conditions:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for all fans, pumps, etc.
 - 4. All automatic and manual dampers are operable and fully open.
 - 5. Volume dampers are in place and open.
 - 6. Hydronic systems are pressure tested, flushed, filled, and properly vented.
 - 7. Leak testing on duct system has been performed if and as required.
 - 8. Start up or construction strainers have been removed and all other proper strainers are clean and in place.
 - 9. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 10. Duct systems are clean of debris.
 - 11. Fans are rotating correctly.
 - 12. Fire and volume dampers are in place and open.
 - 13. Air coil fins are cleaned and combed.
 - 14. Access doors are closed and duct end caps are in place.
 - 15. Air outlets are installed and connected.
 - 16. Duct system leakage is minimized.
 - 17. Pumps are rotating correctly.
 - 18. Service and balancing valves are open.
 - 19. Gauges and/or test ports are properly located for balancing.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. The Contractor shall test, adjust and balance per ASHRAE 2007 HVAC Applications Handbook Chapter 37 the following systems:
 - 1. Supply air systems (Tolerance 5 percent \pm mains 10 percent \pm remainder).
 - 2. Return air systems (Tolerance 5 percent \pm mains 10 percent \pm remainder).
 - 3. Exhaust air systems (Tolerance 5 percent \pm mains 10 percent \pm remainder).
 - 4. Hydronic systems (Tolerance 5 percent \pm mains 10 percent \pm remainder).
 - 5. Steam systems (Tolerance 5 percent \pm mains 10 percent \pm remainder).
 - 6. Equipment associated with the above systems.
 - 7. Operation of the ATC system associated with the above systems.
 - 8. Sound and vibration levels associated with the above systems.

3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. If a balancing device is required to meet project requirements it shall be provided. The Mechanical Contractor shall perform all work required to provide the balancing device and access to such devices at no additional cost to the project.
- H. During all procedures, it be demonstrated that the systems are free from leaks and all parts of the system will operate correctly. The TAB firm shall make final adjustments to all equipment and make recommendations to the automatic temperature control mechanics as may be required for proper operation, maintaining correct temperatures in all parts of the building. Controls shall be adjusted by the temperature control mechanics on the advice of the TAB firm. All test reports shall include documentation of the time date, and personnel performing the tests. Each report must include the ambient outside air temperature and humidity, indoor ambient temperature and humidity, and description of outdoor weather at the time of the test.
- I. Enlist cooperation of the equipment manufacturer when needed to obtain equipment performance. Obtain startup and installation manuals as required.

- J. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- K. Check and adjust systems approximately six months after final acceptance and submit report.
- L. In addition to the above work, check the operation of all automatic temperature control equipment; verify all thermostat, aquastat, airstat, etc., setpoints and operations, and enlist the aid of the control subcontractor to make necessary adjustments where required.
- M. Provide all oil and grease of the proper grade in all bearings. Contractor shall be held responsible for all damage to bearings operating during tests.
- N. Performing testing, adjusting and balancing:
 - 1. Contractor shall cut piping and ductwork insulation, cut ductwork, and drill piping for the installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
 - 2. Contractor shall after performing the TAB procedures plug piping water tight, patch ductwork air tight and patch insulation and re-establish integrity of the vapor barrier. Materials used shall be identical to those removed, cut or drilled.

3.5 AIR SYSTEM PROCEDURE

- A. Ductwork systems installed above plaster, drywall, or other hard material ceilings or ductwork installed 16 feet-0 inches or greater above the floor shall be leak tested to the pressure class rating of that segment of ductwork for 4 hours before the ceiling is installed and/or before the erecting scaffolding is removed.
- B. After the ductwork has passed the leak test, duct insulation, if required as specified, shall be applied.
- C. All ductwork shall be checked and cleared of debris before tests are conducted.
- D. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
- E. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- F. Measure air quantities at air inlets and outlets.
- G. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- H. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- I. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- J. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

- K. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- L. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- M. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- N. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- O. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.
- P. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- Q. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.
- R. Testing and adjusting of individual inlets and outlets shall be performed under procedures recommended by the manufacturers of the inlets and outlets. All inlets and outlets shall be set for air pattern required and all main supply air and return air dampers to be adjusted and set for design CFM indicated. Any required changes in air patterns, settings, etc., necessary for achieving correct air balance, shall be provided by this Contractor. Total CFM of all units shall agree with total CFM of all branches and the grand total shall agree with the air volume for the fans.
- S. After completion of tests, adjustments and balancing under minimum fresh air conditions, set the system for 100 percent fresh air. Repeat the Test for Total CFM above to check field versus design conditions. The results under 100 percent fresh air cycle shall agree with conditions found under "minimum fresh air operation" before the system is considered to be in balance. Adjustments of the proper dampers shall be made to achieve balance.
- T. After completion of tests, adjustments and balancing the Contractor shall seal all test ports air tight with duct sealant. Plugs shall not be used.

3.6 WATER SYSTEM PROCEDURE

- A. All hydronic piping shall be tested at 125 psig, unless specified elsewhere to be tested at a higher psi, before insulation is applied and for at least 4 hours. Repair all leaks and retest until system is proven tight at test pressure. See Section 23 05 03 for any additional test requirements.
- B. Prepare itemized equipment schedules, listing all heating and/or cooling elements and equipment in the systems to be balanced. List in order on equipment schedules by pump or zone according to the design, all heating and/or cooling elements, all zone balancing valves, and circuit pump ending with the last items of equipment or transfer element in the respective zone or circuit. Include on schedule sheet column titles listing the location, type of element or apparatus, design conditions, and measured conditions. Prepare individual pump report sheets for each zone or circuit.

- C. Adjust water systems, after air balancing, to obtain design quantities.
- D. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.
- E. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- F. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.
- G. Adjust hydronic distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- H. Test pumps and adjust flow. Record the following on pumps report sheets: (a) suction and discharge pressure, (b) running amps and brake horsepower of pump motor under full flow and no flow conditions, (c) pressure drop across pump in feet of water and total GPM pump is handling under full flow conditions.
- I. Where available pump capacity is less than total flow requirements or individual system parts, proportional balancing must be performed.

3.7 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. Air Coils.
 - 2. Air Handling Units.
 - 3. Fans.
 - 4. Air Terminal Units.
 - 5. Air Inlets and Outlets.
 - 6. Packaged Rooftop Units.
- B. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
 - 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system

- c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
3. Instrument List:
- a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
4. Electric Motors:
- a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, design, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
5. V-Belt Drive:
- a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
6. Heating Coil Data:
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Water flow, design and actual
 - g. Water pressure drop, design and actual
 - h. Entering water temperature, design and actual
 - i. Leaving water temperature, design and actual
 - j. Entering air temperature, design and actual
 - k. Leaving air temperature, design and actual
 - l. Air pressure drop, design and actual
 - m. Kw
 - n. Number of steps/SCR
 - o. Volts/Phase/Hertz
 - p. Amps per step
7. Air Moving Equipment:
- a. Location
 - b. Manufacturer

- c. Model number
- d. Serial number
- e. Arrangement/Class/Discharge
- f. Air flow, specified and actual
- g. Return air flow, specified and actual
- h. Outside air flow, specified and actual
- i. Total static pressure (total external), specified and actual
- j. Inlet pressure
- k. Discharge pressure
- l. Sheave Make/Size/Bore
- m. Number of Belts/Make/Size
- n. Fan RPM

8. Return Air/Outside Air Data:

- a. Identification/location
- b. Design air flow
- c. Actual air flow
- d. Design return air flow
- e. Actual return air flow
- f. Design outside air flow
- g. Actual outside air flow
- h. Return air temperature
- i. Outside air temperature
- j. Required mixed air temperature
- k. Actual mixed air temperature
- l. Design outside/return air ratio
- m. Actual outside/return air ratio

9. Exhaust Fan Data:

- a. Location
- b. Manufacturer
- c. Model number
- d. Serial number
- e. Air flow, specified and actual
- f. Total static pressure (total external), specified and actual
- g. Inlet pressure
- h. Discharge pressure
- i. Sheave Make/Size/Bore
- j. Number of Belts/Make/Size
- k. Fan RPM

10. Duct Traverse:

- a. System zone/branch
- b. Duct size
- c. Area
- d. Design velocity
- e. Design air flow
- f. Test velocity
- g. Test air flow
- h. Duct static pressure
- i. Air temperature

- j. Air correction factor
- 11. Duct Leak Test (See Section 23 31 00 for Leakage Classification):
 - a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 - 1. Blower
 - 2. Orifice, tube size
 - 3. Orifice size
 - 4. Calibrated
 - g. Test static pressure
 - h. Test orifice differential pressure
 - i. Leakage
- 12. Terminal Unit Data:
 - a. Manufacturer
 - b. Type (constant, variable, single, fan powered)
 - c. Identification/number
 - d. Location
 - e. Model number
 - f. Size
 - g. Minimum static pressure
 - h. Minimum design air flow
 - i. Maximum design air flow
 - j. Maximum actual air flow
 - k. Inlet static pressure
 - l. Control sequence
 - m. Coil data (See #10)
 - n. Fan data (See #14)
 - o. Electric motors (See #4)
- 13. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow
 - k. Associated fan system space temperature

END OF SECTION 23 05 93

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SECTION 23 0700 - HVAC INSULATION

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SECTION 23 0700 – HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. HVAC piping insulation, jackets and accessories.
- B. Related Sections:
 - 1. Comply as applicable with Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
 - 2. Section 09 90 00 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
 - 5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - 6. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - 7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 - 10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 17. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
 18. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
 19. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
 20. ASTM D1785 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 21. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
 22. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
 23. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
 24. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials.
- B. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- C. Underwriters Laboratories Inc.:
1. UL 1978 - Standard for Safety for Grease Ducts.
- D. National Fire Protection Association.
1. NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.
 2. NFPA 255 Method of Test of Surface Burning Characteristics of Building Materials.
 3. NFPA 259 Standard Test Method for Potential Heat of Building Materials

1.4 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Samples: Submit two samples of representative type illustrating each insulation type.

1.5 SUBSTITUTIONS

- A. Comply as applicable with Section 01 60 00 – Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.6 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. The execution of the work shall be in accordance with the manufacturer's instructions and recommendations, the best practice of the trade and the intent of these specifications. All insulation shall be installed over only clean, dry equipment, ductwork and piping.
- E. All insulation, jackets, or facings, and adhesives used to adhere jacket or facing to the insulation, including fittings and butt strips, shall have a non-combustible fire and smoke hazard system rating and label as tested by ASTM E2231, ASTM E84, NFPA 255, and UL723 not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Accessories such as adhesives, mastics, cements, tapes and cloth for fittings shall have the same ratings as listed above. All products or their shipping cartons shall bear the Underwriter's label indicating that flame and smoke ratings do not exceed the above criteria. Staples will not be permitted.
- F. Maintain ambient temperatures and conditions required by manufacturers of all adhesives, mastics and insulation cements.
- G. Insulation materials must be manufactured at facilities certified and registered with an approved registrar to conform to ISO 9001 quality standard.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

- B. Applicator: Company specializing in performing Work of this section with minimum three five years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver all materials (insulation, coverings, tapes, cements, adhesives, coatings, etc.) to the jobsite in factory containers with manufacturer's label showing manufacturer, product name, and product fire hazard information.
- C. Protect the insulation from dirt, water, chemical attack and mechanical damage before, during, and after installation.
- D. Insulation materials that have become wet or contaminated shall not be installed.
- E. Installed insulation which has not been weatherproofed and which is not protected by roof and walls shall be protected from precipitation by waterproof sheeting installed by the Contractor. Wet or damaged insulation shall be removed and replaced by the Contractor at no additional cost.
- F. Maintain jobsite temperature and conditions, before, during, and after installation, as required by the manufacturers of insulation, adhesives and coatings.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Comply as applicable with Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours or as recommended by manufacturer.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 EXISTING CONDITIONS

- A. Contractor shall examine existing insulation and repair or replace in kind or as specified within insulation to limits as indicated on the drawings.

1.13 WARRANTY

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for man-made fiber.

PART 2 PRODUCTS

2.1 SCOPE OF THE WORK

- A. The scope of the work to be performed under this Section of the Specifications shall consist of furnishing all labor and furnishing and installing all material and appurtenances for the insulation covering of the various system components. All work unless otherwise noted, shall be performed by skilled mechanics of the Contractor. The work shall include, but not necessarily be limited to the following:
 - 1. Insulation covering of all new steam, steam condensate, makeup water, glycol heating water, and air conditioning condensate piping.
 - 2. Aluminum jacketing on all exterior insulated water, glycol, steam and condensate piping.
- B. Pressure test all systems before applying insulation.

2.2 GENERAL

- A. All insulation covering shall be of the highest grade of the types specified and shall be installed in a first-class manner. Surfaces of all covering shall be smooth, even and true-to-line, with jackets drawn tight and smoothly secured. Wheat paste and staples shall not be used in the work. No scrap pieces of insulation shall be used where a full length section will fit. Every package or container of insulation, adhesive, jacketing and coating delivered at the building for use shall have the manufacturer's stamp or label attached giving name of manufacturer and brand and quality of material. All surfaces shall be clean, dry and free of all rust and scale when covering is applied. Covering shall be dry when installed and kept dry prior to and during the application of any finish. No covering shall be applied before the affected lines have been tested and proved tight.
- B. All insulation materials shall be delivered to the site and protected against dirt, water, chemical and mechanical damage before, during, and after installation. Damaged and/or wet insulation shall not be installed. Any damaged insulation shall be removed and replaced by the Contractor at no additional cost.
- C. The integrity of the vapor barrier associated with insulation attached to cold surfaces must be maintained at all times. In any cases where the vapor barrier has been compromised due to mechanical damage, the insulation shall be replaced and the vapor barrier shall be made consistent. Repairs and/or replacements shall be performed by the Contractor at no additional cost.

2.3 PRODUCTS – PIPING

A. Manufacturers

1. Johns Manville.
2. Owens Corning.
3. Knauf.
4. IIG.
5. Armacell.
6. K-Plex USA.

B. Model numbers and names are based on Johns Manville, IIG, and Armacell to establish type and quality unless otherwise noted.

C. Fiberglass Pipe Insulation

1. Provide Micro-Lok HP preformed fiberglass pipe insulation with all service (ASJ) vapor- retarder jacket, self-sealing longitudinal closure cap (SSL) and butt strips. Insulation shall comply with ASTM C547, Type 1 and meeting the following requirements:
 - a. Insulation shall be asbestos free and furnished in standard lengths with ends cut square conforming with dimensional requirements of ASTM C585.
 - b. Insulation shall have a thermal conductivity (K) of 0.23 BTU per hour per square feet at 75 degrees F. mean temperature per ASTM C518.
 - c. Installed insulation thickness shall meet condensation requirements for severe pipe operation conditions per NAIMA 3E Plus Program.
 - d. Insulation shall have a maximum service temperature not less than 850 degrees F. and insulation with ASJ and SSL shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50 when tested in accordance with ASTM E84, UL 723, or NFPA 259.
 - e. Material shall be limited combustible as defined in NFPA 90A with a potential heat value not to exceed 3500 BTU per pound when tested in accordance with NFPA 259.
 - f. ASJ with SSL vapor retarder jacket shall be a white kraft paper, reinforced with a glass fiber yarn and bonded to aluminum foil with self-sealing longitudinal closure laps and butt strips shall comply with ASTM C1136.
2. Indoor Piping Systems
 - a. Preformed fiber glass pipe insulation shall be applied to piping with all joints tightly fitted to eliminate voids. Longitudinal jacket laps and butt strips shall be smoothly secured according to manufacturer's recommendations. When adhered, the lap and butt strips must be pressurized by rubbing firmly with to ensure positive closure. The installed insulation thickness shall be enough that the surface temperature shall be kept below 150 degrees F. (66 degrees C).
 - b. All pipe insulation shall be continuous through wall and ceiling openings and sleeves, except where fire stop materials are required.
 - c. Insulation on all surfaces must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchor, etc. that are secured directly to cold surfaces must be adequately insulated

and vapor sealed to prevent condensation. The butt end of every fourth pipe insulation section on chilled water systems shall be sealed with vapor retarder mastic.

- d. All surface finishes are to be extended to protect all surfaces, ends and raw edges of insulation, ends or raw edges of insulation terminations at equipment connections, or fittings shall be sealed with vapor retarder mastic.
- e. Rigid insulation inserts shall be installed on pipe sizes 1½ inches (38 mm) or larger under outside hangers. The thickness of inserts shall be equal to the thickness of the adjoining insulation and shall be provided with vapor retarder seals.
- f. Insulation inserts shall not be less than the following lengths:

PIPE SIZE (inches)	LENGTH (inches)
1½ - 2½	10
3 – 6	12
8 – 10	16
12 and up	22

- g. Galvanized metal shields shall be applied between hangers or supports and the pipe insulation. Shields shall be formed to fit the insulation and shall extend up to the centerline of the pipe and shall be of the length specified for the insulation hanger inserts less 4 inches to allow for vapor retarding butt joints on each side of the shields.
 - h. Specified adhesives, mastics and coatings shall be applied at the manufacturer's recommended minimum coverage per gallon.
 - i. Fittings, valves and-flanges shall be insulated to the same thermal performance (R- Value) as the pipe insulation with Hi-Lo Temp insulation inserts or fabricated fitting insulation and covered with Zeston 2000 PVC insulated fitting covers.
 - j. When PVC jacketing is used, care shall be taken to ensure that the surface temperature of the fitting will be kept below 150 degrees F. (66 degrees C) by the use of the proper thickness of insulation and by keeping the PVC cover away from contact with, or exposure to, sources of direct or radiant heat.
 - k. Unions, automatic control valves, steam trap assemblies, flanged connections and flanged shutoff valves on steam piping, steam condensate piping, and heating hot water piping in Mechanical Rooms shall be provided with a thermal blanket insulation per paragraph 2.3 "F". In such cases, the covering in the adjoining piping shall be tapered and neatly terminated.
 - l. Insulation on strainers shall be installed with removable covers for cleaning of strainers. See paragraph 2.3 "F".
 - m. Indoor piping in indirectly conditioned spaces and spaces exposed to physical abuse or in high humidity areas shall have pipe insulation finished with Zeston 2000 PVC Cut & Curled™ jacketing. All joints in jacketing and fitting covers shall be sealed with PVC tape. See Paragraph 2.8 for pipe jacketing.
3. Outdoor Piping Systems
- a. The insulation shall be finished with aluminum jacketing.
 - b. Aluminum jacketing shall be overlapped 2 inches to 3 inches and held in place with metal bands.

- c. Elbows and tees for metal-jacketed systems shall be finished with matching metal fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulation materials with painted aluminum finish.
 - d. Fittings, valves and flanges shall be insulated to the same thermal performance (R- Value) as the pipe insulation with Hi-Lo Temp insulation inserts or fabricated fitting insulation and covered with aluminum insulated fitting covers. All joints shall be sealed using a soft-setting mastic, per manufacturer's recommended installation procedures.
 - 4. Field Quality Control
 - a. Upon completion of installation of the insulation and before system startup, visually inspect and verify that the insulation has been correctly installed.
 - b. Confirm that any damage to the vapor retarder jacket has been properly repaired.
 - 5. Fiberglass insulation shall be provided on the following systems:
 - a. Glycol heating water
 - b. Steam
 - c. Steam condensate
 - d. Cooling coil condensate drain
 - e. Makeup water
 - f. Relief or vent piping (below 55 degrees F. and above 150 degrees F.)
- D. Elastomeric Pipe Insulation
- 1. Provide Armacell Model AP/Armaflex flexible closed cell elastomeric pipe insulation in tube form. Insulation may be provided with self-seal or self-adhesive option and shall meet the following requirements:
 - a. Insulation shall be manufactured without the use of CFC, HFC, or HCFC compounds, formaldehyde and fiber free with low VOC's and shall be produced with an EPA approved antimicrobial product protection for defense against mold formation and be fungi and bacteria resistant per UC 181, ASTM G21/C1338 and ASTM G22.
 - b. Insulation shall have a thermal conductivity (K) of 0.25BTU per inch per hour per square feet at 75 degrees F. mean temperature per ASTM C177 or C 518. Water vapor permeability shall be 0.05 perm per inch per ASTM E96 Procedure A.
 - c. Insulation shall have a maximum service temperature of 220 degrees F. for tubes and 180 degrees F. for sheets. Insulation may be provided on piping with temperatures down to minus 20 degrees F. For temperature below minus 20 degrees consult manufacturer.
 - d. Insulation shall have a flame spread rating not greater than 25 and a smoke developed rating not greater than 50 where tested in accordance with ASTM E84.
 - 2. Fitting insulation shall be fabricated from miter-cut pieces of insulation, overlapped and sealed to adjoining insulation.
 - 3. Seams and joints shall be sealed with Armaflex 520 BLV adhesive.
 - 4. Where insulation is outdoors or exposed in occupied space, provide a 2-coat Armaflex WB finish. Finish shall be semi-gloss white water base latex enamel designed for use on elastomeric pipe insulation for indoor and outdoor use. Finish shall be ultraviolet and ozone resistant.

5. Where located outdoors, provide jacketing as specified in Paragraph 2.6.
6. Elastomeric insulation shall be provided on the following piping system:
 - a. Cooling coil condensate drain.
 - b. Refrigerant piping not factory insulated. (See Paragraph 2.5 E).
 - c. Suction diffusers
 - d. Chiller components not insulated by Chiller Manufacturer.
- E. Foam Glass Insulation:
 1. Foam glass pipe insulation shall be as manufactured by Pittsburgh Corning Corporation and comply with ASTM C5552, Type II. The foamglass pipe insulation shall be furnished in half section 18 inch or 24 inch long segments. Jacketing shall be UL rated all service jacket (ASJ) by Lamtec Corporation, Compac, Alpha Associates, or equal. Sealant shall be Pittseal 444N.
 2. Foam glass insulation shall be applied with all joints and seam buttered with Pittseal 444N sealant and tightly butted together. Insulation sections shall be secured with 3/4 inch x .020 inch thick stainless steel bands at the rate of two (2) bands per section of insulation. All pipe fitting insulation without exception shall be premolded of thickness to match pipe insulation and assembled with Pittseal 444N sealant.

2.4 PIPE JACKETING

- A. Manufacturers:
 1. ITW PABCO/Childers
 2. Standard Metal Products
 3. Johns Manville/Zeston
 4. Proto
- B. Pipe jacket shall be aluminum alloy roll with stucco embossed finish. Jacket shall conform to ASTM B-2.09. Jacket shall be provided with a moisture retarder laminated to the jacket. Jacket shall be .016 inch thickness for piping up to 36 inches diameter, including insulation, and .024 inch thickness for piping above 36 inches diameter, including insulation, and where piping is subject to abuse. Jacket shall have a flame spread index of 0 and a smoke developed index of 5 per ASTM E84.
- C. Jacketing shall include straight runs, fittings and elbows to provide a complete system. Jacketing shall have a 2 inch overlap on both circumferential and longitudinal joints.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. For piping exposed to view in finished spaces: locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through fire rated assemblies. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with vapor retarder mastic. Staples shall not be used.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
 - 1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 - 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 - 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Hot Piping Systems:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both with vapor retarding mastic.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. For systems greater than 140 degrees F: Insulate flanges and unions at equipment.
 - 4. For systems less than 140 degrees F: Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations with mastic.
- F. Inserts and Shields:
 - 1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.

- b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
- 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- G. Insulation Terminating Points:
 - 1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.
 - 2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
 - 3. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces less than 10 feet above finished floor: Finish with aluminum jacket.
- I. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.

3.3 SCHEDULES

- A. HVAC Piping, Ductwork and Equipment Thermal Insulation shall be as scheduled on the drawings.

END OF SECTION 23 0700

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SECTION 23 2216 - STEAM AND CONDENSATE PIPING SPECIALTIES

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SECTION 23 2216

STEAM AND CONDENSATE PIPING SPECIALTIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Steam traps.
 - 2. Air vents.
 - 3. Vacuum breakers.
- B. Related Sections:
 - 1. Section 23 05 03 – Pipes and Tubes for HVAC Piping and Equipment.
 - 2. Section 23 21 16 – Hydronic Piping Specialties.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
 - 2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- B. ASTM International:
 - 1. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.
 - 2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 3. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
 - 4. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- C. Underwriters Laboratories Inc.:
 - 1. UL 393 - Indicating Pressure Gauges for Fire-Protection Service.
 - 2. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.4 PERFORMANCE REQUIREMENTS

- A. Steam Traps:
 - 1. Select to handle minimum of two times maximum condensate load of apparatus served.
 - 2. Pressure Differentials:
 - a. Low Pressure Systems (5 psi and less): 1/4 psi.
 - b. Low Pressure Systems (15 psi maximum): 2 psi.
 - c. Medium Pressure Steam (25 psi maximum): 5 psi.
 - d. Medium Pressure Steam (40 psi maximum): 10 psi.
 - e. Medium Pressure Steam (60 psi maximum): 15 psi.
 - f. High Pressure Steam (100 psi maximum): 30 psi.
 - g. High Pressure Steam (150 psi maximum): 40 psi.

1.5 SUBMITTALS

- A. Comply as applicable with Submittal procedures.
- B. Product Data: Submit for manufactured products and assemblies used in this Project.
 - 1. Manufacturer's data [and list] indicating use, operating range, total range, accuracy, and location for manufactured components.
 - 2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
 - 3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each piping specialty.
 - 4. Submit electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures, application, selection, and hookup configuration. Include pipe and accessory elevations.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 SUBSTITUTIONS

- A. Comply as applicable with Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.7 CLOSEOUT SUBMITTALS

- A. Comply as applicable with Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Operation and Maintenance Data: Submit instructions for calibrating instruments, installation instructions, assembly views, servicing requirements, lubrication instruction, and replacement parts list.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Product Requirements: Product storage and handling requirements.
- B. Accept piping specialties on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Protect systems from entry of foreign materials by temporary covers, caps and closures, completing sections of the work, and isolating parts of completed system until installation.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Comply as applicable with Product Requirements.
- B. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements before fabrication.

1.13 WARRANTY

- A. Comply as applicable with Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer warranty for piping specialties.

1.14 MAINTENANCE MATERIALS

- A. Comply as applicable with Execution and Closeout Requirements: Spare parts and maintenance materials.
- B. Furnish two bottles of red gage oil for static pressure gages.

PART 2 – PRODUCTS

2.1 STEAM TRAPS

- A. All low pressure (15 PSI and below) shall be venturi-type by Steamgard, or if not available float and thermostatic traps having bodies and caps of ASTM-A278 Class 30 cast iron or SG ductile. All internals including float, main valve head/seat, thermostatic air vent, and air vent head/seat shall be stainless steel.
 - 1. Up to and including 2-inch NPS: Steamgard model EP HA.
 - 2. 2-1/2 – inch NPS and larger: Steamgard model UD.
 - 3. Float and Thermostatic Traps: SpiraxSarco Model (FTI, FT or FTB) or as approved equal.
- B. Where Steamgard traps are utilized, the installing contractor shall contact Steamgard for proper sizing and selection of trapping equipment for the application.
- C. Do not install traps in areas which may be subjected to freezing temperatures under normal conditions.
- D. Small terminal devices, such as fan coils, unit ventilators, and convector units are to use Hoffman 17C thermostatic traps, in lieu of SpiraxSarco.

2.2 AIR VENTS – STEAM SERVICE

- A. Manufacturers:
 - 1. Sarco.
 - 2. Spence.
 - 3. Armstrong.
 - 4. Hoffman.
- B. Automatic air vents shall be mounted at high points, end of stream mains and large steam space equipment for immediate removal of contained air or other non-condensate gases in steam spaces. Air vents shall be self adjusting balance pressure thermostatic type. Head shall be hardened and both head and seat shall be stainless steel and renewable. Provide Model VS204 (250 psig), VS206 (250 psig), T202 (125 psig or 6A (15 psig)) air vents.

2.3 VACUUM BREAKERS – STEAM SERVICE

- A. Manufacturers:
 - 1. Sarco.
 - 2. Spence.
 - 3. Armstrong.
 - 4. Hoffman.
- B. Vacuum breakers shall be used on all modulating or on/off steam run heat exchangers and coils. Vacuum breakers shall be installed in the steam supply side between the control valve and exchanger equipment. Bodies shall be brass or stainless steel internals. Provide Model VB14 or VB21 vacuum breakers.

PART 3 – EXECUTION

3.1 INSTALLATION - STEAM SYSTEM SPECIALTIES

- A. Steam Traps:
 - 1. Provide minimum 3/4 inch size on steam mains and branches.
 - 2. Install with union or flanged connections at both ends.
 - 3. Provide gate valve and strainer at inlet, and gate valve [and check valve] at discharge.
 - 4. Provide minimum 10 inch long, line size dirt pocket between apparatus and trap.
- B. Terminate relief valves as indicated. Provide drip pan elbow with drain connection to nearest floor drain.

3.2 PROTECTION OF INSTALLED CONSTRUCTION

- A. Execution and Closeout Requirements: Requirements for protecting installed construction.
- B. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.
- C. Do not install steam pressure gauges until after systems are pressure tested.

END OF SECTION 23 2216

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SECTION 23 31 00 – HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Duct construction, fittings, and materials.
 - 2. Galvanized and galvanized ductwork.
 - 3. Single and double wall spiral round and flat oval ducts.
 - 4. Single and double wall rectangular ducts.
 - 5. Sealants.
 - 6. Flexible ducts.
 - 7. Insulated flexible ducts.
 - 8. Transverse duct connection system.
 - 9. Fabric Duct.
 - 10. Ductwork fabrication.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 – Standards Handbook.
 - 2. AMCA 204 – Balance Quality and Vibration Levels for Fans.
- B. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA – System Air Leakage Test Standard, 2020.
 - 2. SMACNA - HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012.
 - 3. SMACNA - HVAC Duct Construction Standard - Metal and Flexible, 4th Edition (ANSI/SMACNA 006-2020).
- C. Underwriters Laboratories Inc.:
 - 1. UL 181 - Factory-Made Air Ducts and Connectors.
 - 2. UL 705 – Power Ventilators.
- D. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- E. ASHRAE Fundamentals
- F. National Electrical Manufacturers Association:
 1. NEMA MG 1 – Motors and Generators.
 2. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.
- B. The scope of the work to be performed under this Section of the Specifications shall consist of furnishing all labor and furnishing and installing all material, equipment and appurtenances for the sheet metal ductwork and associated equipment for the Heating, Ventilating and Air Conditioning Systems. The work shall be done by skilled mechanics under the direction and supervision of the Contractor.
- C. It is not the intent of these specifications to define limits of labor and work involved by any sub-contractor. It shall be the responsibility of Contractor to define such limits so that all required equipment for a complete system are furnished and installed in accordance with this Section and applicable paragraphs of other Sections of these specifications.
- D. Comply with Division 00 – Procurement and Contracting Requirements.

1.5 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 Submittal Procedures: Submittal Procedures
- B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 3/8 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
 3. Fittings.
 4. Reinforcing details and spacing.
 5. Seam and joint construction details.
 6. Penetrations through fire rated and other walls.
 7. Penetrations through floors and roof.
 8. Terminal unit, coil, and humidifier installations.
 9. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

- C. Contractor shall take note that due to the limited space available surrounding the area of major work, extremely close coordination of the work is an absolute necessity. He shall coordinate the installation of the various duct systems with equipment and utilities, electrical fixtures, conduits and the like, special equipment supported from overhead and other obstructions of the various building trades.
- D. Contractor shall submit double-line detailed shop drawings properly identifying each duct section in the sequence to be assembled in the field indicating all turns in direction or elevation, clearances with piping, building structure, equipment supports, light fixtures, etc. Shop drawings shall also acknowledge thickness of insulation for externally insulated ductwork, piping insulation, duct supports and standing seams of ductwork. Where duct sections cross standing seams with other ductwork or external reinforcements, they shall be coordinated in a manner to avoid unnecessarily lowering the level of new ductwork to a level unacceptable to the Design Professional.
- E. It shall be Contractor's responsibility to have prepared double-line detailed shop drawings and to coordinate the layout of ductwork with all trades to avoid interferences with partition studs, conduits, sprinklers, plumbing risers, horizontal piping and light fixtures. Detailed shop drawings shall be prepared on electronic media AUTOCAD latest edition or compatible software. Sheetmetal, ductwork, because of its bulkiness, shall take precedence.
- F. Before they are submitted to the Design Professional for approval, all shop drawings shall bear the "APPROVED" stamp of the Balancing Contractor and of the General Contractor, indicating that the layout has been examined by the Contractor and that the proposed method of installation including dampers, vanes and other specialties as specified herein have been included to assist him in the proper balancing and controlling flow of air to the various sections of the building.
- G. Product Data: Submit data for duct materials, equipment and accessories.
- H. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- I. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- J. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- K. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.6 SUBSTITUTIONS

- A. Comply as applicable with Section 01 60 00 – Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.7 CLOSEOUT SUBMITTALS

- A. Comply as applicable with Division 01 – General Requirements.
- B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

- C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- B. Construct ductwork to NFPA 90A and NFPA 90B, and NFPA 96 standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.10 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Division 01 – General Requirements.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Comply as applicable with Division 01 – General Requirements.
- B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures during and after installation of duct sealant.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Division 01 – General Requirements.
- B. Protect ductwork and casings from damage.
- C. Protect items from weather and construction dust.
- D. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- E. Storage: Store materials in a dry area indoor, protected from damage.
- F. Handling: Handle and lift items in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.13 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.14 WARRANTY

- A. Comply as applicable with Division 01 – General Requirements.
- B. Furnish one year manufacturer warranty for all items indicated in Part 2.

PART 2 PRODUCTS

2.1 GENERAL

- A. Furnish and install all sheet metal work necessary for the heating, ventilating, air conditioning and exhaust systems to connect the several components comprising each system and all sheet metal ducts to convey the air to and from the several outlets and inlets, together with all dampers, baffles, guide vanes, supports and other items necessary to accomplish the circulation of the volume of air required by the drawings at each outlet and inlet.
- B. Attention is called to the requirements of this specification that it is the obligation of the Contractor to furnish a sheet metal installation which will supply and exhaust the quantities of air required by the drawings at the several outlets, and to make such changes as may be necessary to accomplish this result. To this end, the ducts, dampers, elbows guide vanes and other details shall be installed as shown and specified and no deviations shall be made without the permission of the Design Professional.
- C. All ductwork, including all construction features, shall be in complete accordance with the latest editions of the ASHRAE Guide and the Guides of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

2.2 DUCTWORK CONSTRUCTION

- A. Except as otherwise specified, ductwork construction for supply, return, mixed, and exhaust air shall conform to SMACNA "HVAC Duct Construction Standards", latest edition.
- B. Except as otherwise specified, ducts shall be fabricated sheets as listed in SMACNA "HVAC Duct Construction Standards".
- C. Ductwork construction description, SMACNA Pressure Class, Seal Class and Leakage Class for the various systems shall be as scheduled on the drawings.
- D. Airtight construction shall be with longitudinal seams continuously welded. Stiffeners shall be plug or spot welded. Transverse joints shall be "TDC" bolted, companion angle and/or Van Stone connectors with cadmium plated hardware in galvanized ductwork and 316 stainless steel hardware in 316 galvanized steel ductwork with 6 inch minimum on centers and gasket. Exposed, uninsulated ductwork shall be flush flat seam. Provide airtight concrete, masonry, and other construction materials for plenums and shafts where noted.
- E. All ductwork shall be sealed per SMACNA Duct Construction Standards Metal and Flexible Manual with a Seal Class "A".
- F. All ductwork shall meet SMACNA standards per HVAC Air Duct Leakage Test Manual. Ductwork shall have Duct Leakage Classification of 6.
- G. Ductwork sizes indicated on drawings are sheet metal dimensions and does include internal duct lining

where specified. See acoustical duct lining paragraph for lining requirements and thickness.

- H. All parts of the ducts and casings shall be constructed with mechanically secure, airtight joints and seams of types approved. Ducts and casings shall have external reinforcement as specified and as necessary to keep them true to shape and free of buckling, noise, or vibration when fans are started, stopped, or pulsating while in continuous operation. When necessary they shall be stiffened additionally by crossbreaking or beading, except on externally insulated and internally lined ductwork. All ductwork sections shall be installed so that they are parallel to building lines.
- I. All galvanized areas that have been damaged by welding shall be coated with corrosion-resistant aluminum paint.
- J. Where air ducts pass through walls or partitions in the fan rooms or if exposed in other areas, the excess space between the duct and the opening will be packed with mortar within a 1/2 inch to the duct after which Contractor shall apply caulking at the joint at the wall face. All around the duct shall be covered by sheet metal angles fastened to the duct and to the wall.
- K. Where ducts pass through floors or fire walls, the space around the duct shall be packed with fiberglass and sealed at both ends with caulking similar to JM Clipper Duxseal or Passive Fire Protection Partners (PFPF) Fire-Stop. Contractor may use sheet metal angles below the floor or roof to retain the packing.
- L. Penetrations through walls, floors, and ceilings by ductwork, spaces shall be sleeved, packed, and sealed.
- M. Transverse duct connections on round spiral ductwork shall be gasketed Van Stone duct joint as detailed for negative 4" and 6" wg pressure classes and Spiralmate for positive 2", 2 1/2" and 3" wg and negative 2" wg pressure class.

2.3 DUCTWORK FITTINGS

- A. Except where square elbows are indicated on the drawings, bends in low pressure ducts shall be made with a center line radius not less than 1-1/2 times the width of the duct. If, because of structural or other limitations, the center line radius must be less than 1-1/2 the duct width, interior guide vanes shall be provided. All square elbows shall be constructed with low loss, double thickness extended trailing edge interior guide vanes equal to H-E-P, High Efficiency Profile on side rails by Aero/Dyne Company, Ductmate, L.C. Ward, or approved equal.
- B. Where turning vanes are installed, they shall be hemmed with 1/2 inch fold back on the leading edge and reinforced by rods or sectional construction vanes shall be constructed of 20 gauge.
- C. Vanes and vane supports shall be installed with leading and trailing edges parallel to duct sides. Vanes used when inlet and outlet sizes are equal are not acceptable on size change elbows without modification.
- D. Where ducts or flues are reduced or increased in size, the slope of the tapered side shall not exceed 1 in 5 and minimum length shall be not less than 2 feet. Attention is called to this requirement particularly with regard to ducts connecting to supply air grilles.
- E. Provision shall be made for the installation of temperature control system dampers specified elsewhere in the specification. Ducts and casings shall be reinforced where necessary for the installation of control devices, thermometers, and similar equipment, whether furnished under this or other contracts.
- F. At each round take-off from ductwork, connections shall be made with flanged and rolled conical tee or

bellmouth fittings with damper or flanged standard 45 degree rectangular-to-round fitting with damper.

1. Connection flanges shall be ½ inch, pre-drilled mounting holes and have 1/2 inch x 1/8 inch thick Air-Tite neoprene gasket.
 2. Bellmouth fitting with damper shall be Model BMD and rectangular-to-round fitting with damper shall be Model 3300D as manufactured by Buckley Associates, Inc.
- G. Where ducts are reduced or increased in size, the slope of the tapered side shall not exceed 1 in 5 and minimum length shall be not less than 2 feet. Attention is called to this requirement particularly with regard to ducts connecting to supply air grilles.
- H. Pipe-to-pipe joints shall be made with sleeve couplings reinforced with rolled beads. Pipe-to-pipe fitting joints shall be made with slip-fit of projecting collar of the fitting of the pipe. Insertion length of sleeve coupling and fitting collar shall be 2 inches for ducts up to 9 inches in diameter and 4 inches for larger sizes.

2.4 DUCT MATERIALS

A. Galvanized Ductwork

1. Ductwork shall be constructed of galvanized steel or galvanized zinc-iron alloy coated steel sheets with airtight locked joints. Galvanized and galvanized steel shall be in accordance with G-90 per ASTM A90/A90M, ASTM A-653/A653M and ASTM A-924/A924M. Galvanized steel shall have a gray, unspangled A60 coating that is ready for immediate painting following normal cleaning.
2. Ductwork utilized for the services listed below shall be galvanized ductwork where concealed or thermally insulated or shall be galvanized where exposed or be painted.
 - a. Supply air
 - b. Return and relief air
 - c. Exhaust air (unless noted otherwise)
 - d. Transfer air

B. Round and Flat Oval Ductwork

1. Manufacturers
 - a. McGill Airflow.
 - b. Lindab.
 - c. Semco.
 - d. Sheet Metal Contractor.
2. Specifications are based on McGill Airflow to establish type and quality unless otherwise noted.
3. All duct and fittings shall be manufactured by a company for whom the manufacturer of spiral duct and welded fittings has been a principal business for at least 15 years. All duct and fittings covered by this specification shall be manufactured by a single company.
4. All duct and fittings shall be a minimum G-60 galvanized or galvanized sheet metal in accordance with ASTM A653/A653M and A924/A924M specifications. Gauges are to be in accordance with current SMACNA standards.
5. Ductwork shall be single wall UNI-SEAL round spiral lockseam construction or continuously welded longitudinal seam duct construction. Longitudinal seam duct shall be used in those sizes greater

than as indicated above for sizes up to 60 inches and other odd sizes for which spiral duct is not available, or where duct is exposed in occupied (public) spaces. Standard gauges shall be in accordance with SMACNA standards.

6. Ductwork shall be provided in continuous, unjoined lengths wherever possible. Except when interrupted by fittings, round and flat oval duct sections shall not be less than 12 feet long.
7. All ducts subject to negative pressure shall be of spiral lockseam construction, within the range of available spiral sizes, for the required gauge.
8. Duct gauge and reinforcement requirements shall depend on diameter or flat oval perimeter, maximum operating pressure, and type of particulate, gas, or mist being conveyed. Applicable gauge and reinforcement requirements shall be in accordance with manufacturer's recommendations.
9. Fittings shall be by the ductwork manufacturer, round or flat oval as determined by the duct configuration, and in accordance with SMACNA standards.
10. Unless otherwise specified, standing seam joints shall be used wherever possible on all fittings. All standing seam joints shall be sealed with UL-Classified cement in lieu of standing seam construction, joints may be tack or spot welded and sealed.
11. The outside of all welded joints on galvanized fittings shall be coated with a protective paint to prevent damage to the galvanized surface. Spot welded fittings shall have all joints sealed with UL-Classified cement.
12. Elbows shall be of die-stamped, gored, pleated, or mitered construction. The bend radius of stamped, gored, and pleated elbows shall be 1.5 times the elbow diameter. Unless elbow construction type is specified on drawings or contract documents, the following requirements shall apply:
 - a. Round elbows in diameters of 12 inches or less shall be of 22 gauge minimum die-stamped (45 and 90 degrees) construction. Nonstandard bend angle configurations or ½ inch diameter (e.g., 3½ inches, 4½ inches, etc.) elbows shall be of gored construction.
 - b. Round 90° elbows in diameters of 9 inches through 14 inches (45 and 90 degrees) shall be of 26 gauge pleated construction. Nonstandard bend angle configurations or ½ inch diameter (e.g., 9½ inches, 10½ inches, etc.) elbows shall be of gored construction.
 - c. All round elbows in diameters greater than 14 inches shall be of gored construction, and all round elbows in diameters of 32 inches or greater shall be of tack or spot welded and sealed or fully welded construction. All flat oval elbows shall be of gored, tack or spot welded and sealed construction.
 - d. Mitered elbows shall be used only where space restrictions do not permit the use of 1.5 bend radius elbows.
13. Diverging flow fittings shall be constructed with a radiused entrance to all branch taps and with no excess material projecting from the body into the branch tap entrance. All takeoff or branch entrances shall be by means of factory-fabricated fittings or factory-fabricated duct/tap assemblies.
14. Access doors shall be provided immediately downstream of all fire or smoke-dampers and elsewhere as indicated on drawings. All access doors used for resetting dampers, cleaning filters, or performing general maintenance inside duct systems shall be standard bolted access doors or equivalent as specified elsewhere.
15. Provide a relief-type access door immediately downstream of all smoke and fire dampers (or other

dampers subject to sudden closure) when there is no branch takeoff is not sufficient to relieve the negative pressure if a damper closes suddenly. Door shall be by ductwork manufacturer.

16. Only fittings with verifiable loss coefficients and performance data developed from actual laboratory testing will be acceptable. Performance data on fittings must be furnished upon request.
17. The entrance to tees or wyes for round ductwork shall be free of weld buildup, burrs, or irregularities and fabricated by machine or press formings. All divided flow fittings shall be manufactured as separate fittings, not as tap collars welded into spiral duct sections.
18. All round ductwork and fittings rated for scheduled Pressure Class or higher shall be installed with a sealer applied to the male end of the couplings and fittings. After the joint is slipped together, sheet metal screws shall be placed a ½ inch from the joint bead for mechanical strength. Apply sealer to the outside of the joint extending 1 inch on each side of the joint bead and cover the screws and follow with plastic backed tape immediately over the wet sealer. Sealer and tape must be compatible to properly cure and bond together and must be suitable for high-pressure systems. Sealer shall be a soft-setting vinyl acrylic type equal to "Uni-Grip". Gasket sealer for flanged joints shall be "Ventlok 797 Sealer" manufactured by Ventfabrics, Inc. Before any sealer is applied, all surfaces to be sealed shall be clean, dry, and free from oil or grease. Submit samples and specification data for approval.
19. All galvanized areas that have been damaged by welding shall be coated with corrosion-resistant aluminum paint.
20. Where ducts pass through floors, roof, or fire walls, the space around the duct shall be packed with fiberglass and sealed at both ends with caulking similar to J. M. Clipper Duxseal. Contractor may use sheet metal angles below the floor or roof to retain the packing.
21. Penetrations through roofs, walls, floors, and ceilings by ductwork spaces shall be sleeved, packed, and sealed.
22. All fittings and ductwork sections shall be installed per manufacturer's recommendations.
23. If the Sheet Metal Contractor provides this ductwork the above specifications shall be followed.

2.5 DOUBLE WALL ROUND AND FLAT OVAL DUCTWORK

- A. Manufacturers:
 - a. McGill AirFlow
 - b. Semco
 - c. Sheet Metal Contractor
- B. McGill AirFlow LLC ACOUSTI-k27® double-wall (insulated) duct is the basis of design unless otherwise specified to establish type and quality and shall be provided. Unless otherwise indicated, all insulated duct diameters shown on drawings are nominal inner liner dimensions.
- C. Insulated duct shall be constructed of a galvanized, perforated metal liner in accordance with the following:

Metal Diameter (in.)	Gauge	Construction
3-8-1/2	28	Spiral

9-42	28	Ribbed Spiral
44-60	26	Ribbed Spiral
62-84	22	Spiral

- D. Round double wall duct with perforated metal liner shall have the acoustical performance that is equal to or exceeds that of McGill AirFlow. Perforations in the inner walls shall have an overall open area of 23 percent. A layer of fiberglass insulation of 1, 2 or 3 in. thick and the outer pressure shell gauge shall always be based on outer shell dimensions.
- E. All insulated duct shall have a maximum thermal conductivity (k) of 0.25 Btu/hr/sq ft/deg. F/inch thickness at 75 deg. F mean temperature equal to Johns Manville Spiral 5G, Type 125.
- F. Insulation ends shall be provided at all locations where internally insulated duct connects to single-wall duct or to any non-insulated component. The insulation end shall terminate the insulation and reduce the outer shell diameter to the nominal single-wall size.
- G. Double wall (insulated) fittings of similar construction shall be provided.
- H. A layer of fiberglass insulation of 1, 2 or 3 in. thick and the outer pressure shell gauge shall always be based on outer shell dimensions. All insulated fittings shall have a maximum thermal conductivity (k) of 0.25 Btu/hr/sq ft/deg. F/inch thickness at 75 deg. F mean temperature.
- I. All double-wall round and flat oval connections shall be 3-36 in. diameter slip couplings with sealant and screws. Connections greater than 36 in. diameter shall be similar to McGill AirFlow Uni-Flange[®] attached with internal flange with sealant and joined with tec screws on 10 inch centers or tack welds. Mating flanges of T-25 connectors shall be joined at 6-8 inches on centers using #10 tec screws.
- J. Duct manufacturer shall provide manifolded fittings on minimum 10 and maximum 20 foot sections of duct. Factory installed Uni-Flanges are to be provided on ductwork. Layout drawings of ductwork shall be provided by duct manufacturer.
- K. Round double wall ductwork outer pressure shall be galvanized zinc-iron alloy coated steel where located exterior of the building or is to be painted.

2.6 RECTANGULAR SINGLE AND DOUBLE WALL DUCTWORK

- A. Manufacturers:
 - a. McGill AirFlow
 - b. Semco
 - c. Sheet Metal Contractor
- B. Single-wall rectangular duct and fittings shall be sealant filled Pittsburgh-lock longitudinal seam construction. Duct shall be provided in standard nominal 5-foot or 6-foot lengths. Standard construction shall conform to the latest SMACNA HVAC Duct Construction Standards – Metal and Flexible. Duct shall be shipped in sections for field erection, and fittings shall be shipped fully assembled unless otherwise specified.
- C. Duct and fittings shall be fabricated from a minimum G-90 galvanized steel (ASTM A653 and A924) in accordance with the standard gauges, reinforcements and end connections shown in SMACNA.

- D. Duct and fittings shall be beaded when side dimensions are greater than 19 inches, construction is 20 gauge or lighter, pressure rating is 3 inches wg. or less and there is more than 10 square feet of unbraced panel area. Cross-breaking is acceptable. Beading or cross-breaking is not required for ductwork with an insulation covering or acoustical liner.
- E. All rectangular or square-throated elbows and tees shall be provided with factory-installed, double-wall, hollow turning vanes or single thickness trailing edge type tuning vanes in accordance with SMACNA recommendations. Turning vanes are not required in radius fittings.
- F. Tie-rod reinforcement shall be constructed of ½-inch galvanized conduit using Easyrod fasteners and shall be provided loose for field installation unless otherwise specified. Tie rods installed in the factory or field shall be located in accordance with SMACNA recommendations.
- G. All seams shall be sealed with-Classified 25 flame spread and 50 smoke developed sealant or better in accordance with SMACNA duct sealing requirements.
- H. All TDC and applied connectors at transverse joints shall be sealed using a butyl rubber gasket that is installed in the field. All S & drive slip transverse joints shall be sealed with United Duct Sealer (Water Based) or approved equal.
- I. Double-wall duct and fittings shall be of Pittsburgh-lock longitudinal seam construction with TDC transverse duct connectors. Duct shall be provided in standard nominal 5-foot or 6-foot lengths. Standard construction shall conform to the latest SMACNA HVAC Duct Construction Standards - Metal and Flexible. Duct and fittings shall be shipped fully assembled.
- J. Duct and fittings shall be fabricated from a minimum G-90 galvanized or galvanized steel (ASTM A653 and A924) in accordance with the standard gauges, reinforcement and end connects shown in SMACNA.
- K. All rectangular or square-throated elbows and tees shall be provided with factory-installed double wall hollow turning vanes or single thickness trailing edge type turning vanes in accordance with SMACNA recommendations. Turning vanes are not required in radius fittings.
- L. Insulation shall be fiberglass of scheduled thickness and shall be applied to the inner surface of the outer shell using UNI-TACK™ duct liner adhesive or approved equal. Vapor barriers and coated insulation shall be supplied where noted on drawings.
- M. The inner liner of duct and fittings shall have an overall open area of about 23 percent. Solid inner liners shall be supplied where noted on the drawings.
- N. The acoustical performance of double wall duct and fittings shall be as shown in ASHRAE Handbooks. Insulated duct shall have a maximum thermal conductivity (k) of 0.25 Btu/hr/sq ft/°F/inch thickness at 75°F mean temperature, equal to Johns Manville Spiral SG, Type 125.
- O. Factory installed flanges are to be provided on ductwork. Layout drawings of ductwork shall be provided my duct manufacturer.
- P. Single and double walled ductwork that is located exterior of the building or is to be painted shall have their outer pressure shell galvanized, zinc-iron alloy coated steel suitable for painting.

2.7 INSULATED FLEXIBLE DUCTWORK

- A. Flexible duct for connections between rigid sheet metal ductwork and supply air devices shall be a factory fabricated assembly consisting of an inner duct, insulation and an outer moisture barrier. The inner duct shall be constructed of a continuous vinyl-coated spring steel wire helix bonded to a continuous layer of woven fiberglass coated with vinyl. A thick insulating blanket of fiberglass, providing a thermal conductance © factor of 0.23 BTU/hr/sq.ft./ degrees F, shall encase the inner duct and be sheathed with an outer moisture barrier of a reinforced metalized Mylar/neoprene laminate of low-permeability for a suspension system as listed by Underwriters' Laboratories, Inc. under their UL-181 Standards as a Class 1 Air Duct and shall comply with NFPA Standard No. 90A. The flexible duct shall be Thermaflex M-KC, Flexmaster 4M, or approved equal. Maximum total length of flexible duct work shall be 5 feet-0 inches.
- B. Insulated flex ducts shall be used to connect CV and VAV boxes with rigid sheet metal ductwork main shall have an inner core single ply aluminum, mechanically corrugated for strength and airtightness. This inner core shall be covered by 1 inch thick fiberglass of one lb. density. The fiberglass shall be covered with a polyethylene vapor barrier. The flexible duct shall be capable of maintaining the shaping required by job conditions without subsequent sagging or droop. Duct connections to collars shall be made in accordance with the duct manufacturer's recommendations. Insulated flexible duct shall be Clevaflex Type SFV, Flexmaster TLV, or approved equal. Provide Thermaflex M-KE Flexmaster 8M or Casco Silent Flex II for closed office. Minimum total length shall be 5 feet 0 inches.
- C. Flexible air ducts shall not be used above drywall ceilings.

2.8 SQUARE AND RECTANGULAR LONGITUDINAL SEAMS AND TRANSVERSE DUCT CONNECTION SYSTEM

- A. Manufacturers
 - 1. Lockformer Company.
 - 2. C. L. Ward.
 - 3. Engel.
- B. All ductwork rated at a 3 Inch Pressure Class or less shall be constructed with Lockformer Company 'TDC' System transverse joint (T-24, T24A, T-25A, T-25B) and sealant filled PITTSBURGH-LOCK longitudinal seams. Drive and slide joints (T-1) shall be used on ducts 12 x 10 and smaller and shall be taped with Hardcast Inc. AFG-1402 instant tape sealant. Larger ducts shall be assembled with Lockformer Company 'TDC' System with butyl gaskets. Duct joint sealant to be silicone base type. Water based sealants are prohibited. Approved manufacturer is United McGill (no substitutions). All sealants shall be exterior grade UV rated.
- C. All rectangular ducts rated at 4 Inch Pressure Class and higher shall be fabricated and assembled with fusion welded longitudinal butt seams, and flanged and gasketed sealed transverse joints throughout, using zinc-coated steel sheets. Flanged joints for rectangular ducts shall be made with structural steel angles tack-welded to the exterior surface of the duct on 6 inch centers with suitable rods and using a gasket between the face angles forming the flange for air-tight joint (T-22 and T-22ALT). Flanged connections can be made with Lockformer Company 'TDC' System (T-24, T24A, T-25A, T-25B) with butyl gaskets and longitudinal seams shall be sealant filled Pittsburgh lock. Flanges shall be tack-welded on 6 inch centers and have a continuous bead of sealant applied on the pressure side. All field joints and shop assembled seams shall be sealed similarly. Duct joint sealant to be silicone base type. Water based sealants are prohibited. Approved manufacturer is United McGill (no substitutions). All sealants shall be exterior grade UV rated.

2.9 OUTDOOR CASINGS FOR STEAM HUMIDIFIER DISPERSION SYSTEM WITH AND WITHOUT HEATING COIL

A. ACCEPTABLE MANUFACTURERS

1. Basis-of-Design Product: provide product indicated on schedule as YORK® Solution™ Outdoor by Johnson Controls Inc.
2. Alternately, provide product, subject to compliance with requirements, by one of the following:
 - a. Daikin Applied Custom
 - b. Trane Performance Climate Changer, Model CSAA

B. GENERAL DESCRIPTION

1. Casings shall consist of a structural base, insulated casing, access doors, coils, components, and accessories; as shown on drawings, schedules, and specifications.
2. Provide casings to meet the specified levels of performance for scheduled items including airflow, static pressure, heating capacity, sound, casing leakage, panel deflection and casing thermal performance.
3. Casings shall maintain structural integrity when wall panels are removed.
4. Provide internal components and accessories as specified and scheduled. Components and accessories shall be installed by the manufacturer in an ISO-9002 certified facility.
5. Casings shall be ship in one piece. Split unit(s) only where necessary for shipping and installation.
6. Manufacturer shall provide detailed, step-by-step instructions for disassembly and reassembly.
7. Casing segments that must be broken down for rigging and installation: segment shall be disassembled and reassembled by manufacturer's factory-trained service personnel.
8. Manufacturer shall perform a field leakage test to confirm 1% maximum leakage per Section 2.27. Manufacturer shall provide a written statement confirming that the unit is built to the manufacturer's factory standards and that the unit will carry the full warranty.

C. STANDARDS COMPLIANCE

1. Manufacturer shall comply with ratings and certifications referenced in this specification.
2. Manufacturers who do not conform to requirements of AHRI 260 for ducted discharge and return air sound shall submit each casing unit to an independent sound test laboratory for AHRI 260 testing. The test laboratory shall conform to AHRI 260, Section 4.4, Test Equipment and Facilities.

D. BASE RAIL

1. Casings shall be provided with structural base rail under the full perimeter of the unit, formed from mill galvanized steel.
2. Structural steel shall be installed providing clearance for proper external trapping of drain pans and steam condensate.
3. Casings shall be provided with base rail and lifting lug system that does not require additional support for rigging. Include base rail lifting lugs at unit corners.

E. CASING

1. Casing construction shall not rely on the casing panels for structural integrity.
2. Casing panels shall be 2" double-wall construction with thermal break. Thermal break shall be between interior and exterior liner of the panel assembly, and between the panel and casing framework.
3. Provide casing with minimum thermal resistance (R-value) of 13 hr-ft²-°F/BTU. Exposed insulation is not acceptable.
4. Casing panel insulation shall be injected polyurethane foam. Foam insulation shall be manufactured by EcoMate®. Rigid foam board panels shall not be used.
5. All exterior casing panels (roof, wall, floor, access door) shall be made of galvanized steel. All interior casing panels shall be made of stainless steel.
6. Panel assembly shall meet UL standard 1995 for fire safety. Panel insulation shall comply with the requirements of NFPA 90A.
7. Insulation system provided shall be resistant to mold growth in accordance with a standardized test method such as UL 181 or ASTM C 1338.
8. Encapsulate insulation with sheet metal so that air does not contact insulation. Solid lined double-walled panels insulated with injected foam shall be hermetically sealed at each corner and around their entire perimeter to eliminate airflow through the panel and to eliminate microbial growth potential within the casing wall.
9. Unit shall conform to ASHRAE Standard 111 Class 6 for casing leakage no more than 1% of design airflow at 1.25 times design static pressure up to a maximum of +8 inches w.g. in positive pressure sections and -8 inches w.g. in negative pressure sections down to a minimum of 50 CFM measurable leakage or 5,000 design CFM.
10. Provide wall panels and access doors that deflect no more than L/240 when subjected to 1.5 times design static pressure up to a maximum of +8 inches w.g. in positive pressure sections and -8 inches w.g. in negative pressure sections. 'L' is the panel-span length and 'L/240' is the deflection at panel midpoint.
11. Provide floors and roofs that deflect no more than L/240 when subjected to a 300 lb static load at mid-span. 'L' is the panel-span length and 'L/240' is the deflection at panel midpoint.
12. Provide outdoor casings with a roof system that deflects no more than L/240 when subjected to a static snow load of 30 lb./ft². 'L' is defined as the panel-span length and 'L/240' is the deflection at the panel midpoint.
13. Condensation shall not form anywhere on unit exterior at 53 deg F supply air and 95 deg F DB / 78 deg F WB exterior ambient. Manufacturer shall supply an external condensation performance line, plotted on the psychrometric chart, based on actual test data. Plot will show the exterior conditions at which unit will sweat given the design supply air temperature. Manufacturer shall clearly indicate whether the design conditions will or will not result in external condensation forming anywhere on the unit exterior. If the unit will sweat, indicate where sweating will occur. Unit exterior includes the base, base rail, roof, corners, doors, door frames, and under the coil drain pan.

F. ROOF SYSTEM

1. Roof system outer layer
 - a. Shall have no points of penetration.
 - b. Shall use no fasteners.

- c. Shall have no metal-to-metal seams joints.
 - d. Shall not use or require caulking.
2. Roof system shall be warranted by manufacturer against water penetration for a period of 10 years.
 3. Roof system shall be sloped with a minimum pitch of 1/8" per foot.
 4. Roof system shall overhang side and end panels by a minimum of 2."
 5. Doors shall have drip edge guard above door frame. Drip edge guard shall extend 2" beyond door surface.
 6. Field connection at roof of section splits shall not require use of fasteners, sealants or metal seam caps.

G. ACCESS DOORS

1. Provide double wall access door(s) that meet requirements for the casing.
2. Thermal break door(s) shall incorporate a thermal break in both the door frame and the door panel.
3. Provide industrial-style stainless steel hinges that permit 180 degrees of door swing.
4. Provide latches with roller cam mechanisms that ensure a tight seal. Rotating knife-edge or "paw" latches are not acceptable.
5. Provide each door with a single handle linked to multiple latching points or a separate handle for each latching point. Doors serving access segments shall have an interior latch handle.
6. Provide access doors with a locking hasp to accommodate a lockout device.
7. Provide double-pane viewing windows. Windows shall be a non-condensing type consisting of a desiccant dehumidification layer. Minimum dimension shall be 3" x 8".

H. COILS: HEATING

1. Coils shall meet or exceed performance scheduled on drawings.
2. Coils shall be provided with performance certified in accordance with AHRI Standard 410 for coil capacity and pressure drop, wherever applicable. Coils circuits shall be designed such that the fluid velocity is within the range of certified rating conditions at design flow.
3. Coils shall be provided with a maximum face velocity as scheduled. Face velocity calculations shall be based on the finned area of the coil.
4. Cooling coil shall be provided with drain pan that is sufficient to contain coil condensate. Drain pan shall extend a minimum of 6" downstream of the face of the coil.
5. Access panel or door shall be easily operable and are easily removable with no special tools, as shown on drawings.
6. Access doors shall be located to provide clearance for pipe insulation, connectors, and accessories. Space shall allow a minimum of 90 degrees of door swing.
7. Coils shall be built in their own full perimeter frame. Tube sheets on each end shall have fully drawn collars to support and protect tubes. Horizontal coil casing and support members shall allow moisture to drain. Casing and support members shall not block finned area.

8. Individual coils shall be removable from the side of the casing.
9. Coil pull panels shall be provided that are easily removable with no special tools. Coils shall be re-movable from the side of the unit.
10. Gap between coil stub out connection and AHU casing, shall be insulated with a spool-shaped sleeve grommet. Adhesive rings applied to the casing walls shall not be acceptable.
11. Water and glycol coils shall be operable at 325 psig working pressure and up to 250 deg F. Factory test water and glycol coils with 325 psig compressed air under water. Water coils shall conform to Subsection 12.3, "Water-Containing Parts," of UL-207, "Standard for Safety: Refrigerant – Containing Components and Accessories, Nonelectrical."
12. Water and glycol coils shall be provided with a tube OD of 5/8". Mechanically expand tubes shall form fin bond and provide burnished, work-hardened interior surface.
13. Water and glycol coil headers shall be made of seamless copper or brass tubing. Pipe connections shall be red brass. Header connections (tubes and piping connections) shall be silver-brazed or TIG welded.
14. Continuous aluminum or copper fins shall be provided for coils with die-formed fins. Fins shall have fully drawn collars to accurately space fins and protect tubes. Fins shall be 0.01" thick.
15. Coil casing frame shall be stainless steel.

I. PRIMARY DRAIN PANS

1. Unit(s) shall be provided with a drain pans under each coil and humidifier.
2. Provide drain pan under the complete width and length of coil and humidifier sections. Drain pan shall be full width, and extend a minimum of 6" downstream of cooling coil.
3. Drain pans for coils and humidifiers shall meet the requirements of ASHRAE 62.
4. Drain connection shall be made of same material as drain pan. Dissimilar metals shall not be used to mitigate risk of galvanic corrosion. Drain connection shall be welded to the drain pan.
5. Drain pan shall be double wall with an insulation R-value of 6.25 hr-ft²-°F/ (BTU-in).
6. Drain pan shall have minimum of 2" of injected polyurethane foam insulation under the entire bottom surface of the drain pan. Drain pan shall be foam injected as a complete assembly and shall include thermal breaks at connection points to unit casing. Foam insulation shall be manufactured by EcoMate®.
7. Drain pan shall allow visual inspection and physical cleaning on 100% of the pan surface without removal of the coil or humidifier.
8. Provide a minimum of 1" clearance between the drain pan and any coil casing, coil support or any other obstruction.
9. Provide drain pan that allows the design rate of condensate drainage regardless of airflow status.
10. Provide drain pan sloped in at least two planes by at least 1/8" per foot toward a single drain. Locate drain connection at the lowest point of the pan. Pan shall have no horizontal surfaces.

J. PIPE CHASE CABINET

1. Provide pipe chases with double wall, insulated panels. Pipe chase shall have the same thermal performance as the unit casing.
2. Provide a perimeter base rail and/or roof curb under the pipe chase[s] that meets requirements for the casing base rail and/or roof curb.
3. Manufacturer may combine the pipe chase enclosures of adjacent segments.
4. Provide a minimum pipe chase depth, as shown on drawings. Pipe chase depth is the clear inside dimension from inner pipe chase surface to outer unit surface.
5. In case, pipe chases shipped separate from casing, manufacturer shall provide chases with lifting lugs for field installation per the casing base rail requirements 'if required'.
6. Manufacturer shall provide step-by-step instructions with illustrations for proper pipe chase installation.

K. ROOF CURBS

1. Provide factory-fabricated galvanized steel roof curb. Roof curb shall support the full-perimeter of the casing, including pipe chases.
2. Match roof curb to roof slope. Curb surface shall be level in both axes.
3. Provide wood nailing strip to which roofer may nail roof flashing.
4. Ship roof curb loose for field installation prior to unit placement.

L. EXTERIOR FINISHES

1. Manufacturer shall clean the exterior surfaces of units prior to application of exterior protective coating.
2. Manufacturer shall paint exterior surfaces of outdoor units prior to shipment.
 - a. Manufacturer shall apply a primer prior to application of finish coating.
 - b. Exterior finish coating shall show a breakdown of less than 1/8" on either side of a scribed line when subjected to ASTM B117 2,000 hour, 5% salt spray conditions. This is equivalent to an ASTM D1654 rating of '6.' Also, per ASTM D610, degree of rusting to meet #8-G and per ASTM D714 degree of blister to meet #6 medium.

PART 3 EXECUTION

3.1 DUCTWORK

- A. Due to the small scale of the drawings, all changes in direction of ductwork may not be shown. Ductwork shop drawings shall be submitted by the Contractor and shall show all such changes which shall be installed at no additional cost to the Owner.
- B. Where ductwork is specified or indicated to be lined, duct sizes indicated on the drawings shall be sheet metal sizes and includes lining.
- C. All ducts shall be true to the dimensions indicated on the drawings and shall be straight and smooth inside. Ducts shall be anchored securely to building construction in a manner to prevent noise and vibration. The radius of all elbows shall be at least the width of the duct.

- D. All ducts in finished areas of the building shall be concealed unless otherwise indicated on plans. Sheet metal screws shall not be used for joining ductwork. Access openings in ductwork shall be provided with rolled edges to protect personnel against injury.
- E. Duct Sleeve Sound Treatment – Duct penetrations through partitions shall be provided with duct sleeves of construction as specified elsewhere in these specifications. The surrounding space of each duct inside the sleeve shall be packed with fiberglass and sealed at both ends with caulking, similar to J.M. Clipper/Parker Duxseal or Fire-Stop.
- F. Where it is necessary that any portion of the duct system be built around pipes, conduits, beams or other constructions, provide air stream deflectors for smooth flow. If the obstruction is for an appreciable size, the duct is to be enlarged to maintain velocity.
- G. Place balancing damper in each branch duct. They shall have approved means of adjustment and be capable of locking in place with quadrants and levers for wing lock nuts. They are to be located in accessible position. Provide access doors where necessary for access to quadrants. Coordinate with Specification Section 23 05 93.
- H. Provide not less than 1 inch wide No. 12 gauge stock galvanized steel strap or steel rod hangers for hanging sheet metal from building construction and provide intermediate supports on vertical runs from ceiling to floor. Provide supports and hangers as specified in Section 23 05 29. Ducts shall be supported so that vibrations or pulsations are not transmitted to the building. Hangers are to be securely fastened to the sides of the ducts with bolts or rivets at seams and are to be turned at right angles to wall or ceiling and fastened by substantial means. For rectangular ducts, the bands shall be turned under the bottom of ducts and fastened with rivets at the bottom or corner and at intervals not exceeding 6 inches in the sides of duct. Ducts are not to be hung from pipes, conduits, suspended or furred ceilings.
- I. Hangers shall be spaced not more than 8 feet apart and shall be placed as close as practicable to the transverse joints in the duct. The hangers shall be secured to inserts cast into floor construction above where possible or to other permanent building structure elements in an approved manner. No ductwork shall be supported from suspended ceiling construction.
- J. Furnish and install all steel work, hangers and accessories to support all air terminals including registers, grilles, diffusers and other heating, ventilating and air conditioning work and equipment. All such items shall be supported directly from the basic building construction and in no case from any suspended ceiling.
- K. In public areas where ductwork is exposed to view, it shall be hung utilizing wire rope. System shall be Ductmate, Duro-Dyne or equal with EZ-Lock clamps and Clutcher rope hardware. The entire system shall be provided by a single manufacturer and shall be approved by the local authority.
- L. Where ductwork pierces floors and walls, provide 10 gauge galvanized angle iron enclosure between floors, walls and ductwork. Enclosure shall be on both sides of floor and wall except shall be on one side where fire or smoke dampers are not installed and side without enclosure is concealed behind ceiling or pipe spaces or at slab on grade penetrations.
- M. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- N. Slope underground ducts to plenums or low pump out points at 1: 500. Install access doors for inspection.

- O. Connect flexible ducts to metal ducts with draw adhesive plus sheet metal screws.
- P. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.
- Q. Casings: Install floor mounted casings on 4 inch high concrete curbs. Refer to Section 03 30 00. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, furnish liner of 18 gauge galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

3.2 CASING

A. Installation

1. Install equipment per industry standards, applicable codes, and manufacturer's instructions.
2. Casing shall not be used for temporary heating or ventilation prior to complete inspection and startup performed per this specification.
3. Install casing on a roof curb, or structural steel base, as shown on drawings.
4. Install casing with manufacturer's recommended clearances for access, coil pull, and fan removal.
5. Install casing plumb and level. Connect piping and ductwork according to manufacturer's instructions.
6. Install pipe chases per manufacturer's instructions.
7. Insulate plumbing associated with drain pan drains and connections.

B. Field Quality Control

1. AHU shall be stored as per manufacturer's written recommendations.
2. Rig and lift units shall be according manufacturer's instructions.

C. AHU Inspection

1. Hire manufacturer's factory-trained and factory-employed service technician to perform an inspection of unit and installation prior to startup. Technician shall inspect and verify the following as a minimum:
 - a. Damage of any kind
 - b. Level installation of unit
 - c. Proper reassembly and sealing of unit segments at shipping splits.
 - d. Tight seal around perimeter of unit at the roof curb
 - e. Completion and tightness of ductwork and piping
 - f. Tight seals around wiring, conduit and piping penetrations through AHU casing.
 - g. Integrity of condensate trap for positive or negative pressure operation
 - h. Condensate traps charged with water
 - i. Removal of shipping bolts and shipping restraints
 - j. Sealing of pipe chase floor(s) at penetration locations.
 - k. Complete installation of control system including end devices and wiring
 - l. Cleanliness of AHU interior and connecting ductwork
 - m. Proper service and access clearances

D. Field Performance Verification

1. Leakage: Pressurize casing to maximum operating static pressure [up to +/-8" w.g.] and measure leakage. If leakage exceeds 1% of design airflow, seal leakage points with a permanent solution. Repeat test. If the AHU still does not pass, contact the manufacturer to seal unit.
 2. Submit a field test report with testing data recorded. Include description of corrective actions taken.
- E. Cleaning
1. Clean unit interior prior to operating. Remove tools, debris, dust and dirt.
 2. Clean exterior prior to transfer to owner.
- F. Documentation
1. Provide Installation Instruction Manual, & Startup checklist in the supply fan section of each unit.
 2. Provide six copies of Spare Parts Manual for owner's project system manual.

3.3 CLEANING – DUCTWORK AND EQUIPMENT

- A. Coordinate with Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- C. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install Pitot tube openings for testing of systems. Install Pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect grilles, registers, and diffusers to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
- C. Connect air terminal units to supply ducts with five foot maximum length of flexible duct. Do not use flexible duct to change direction.
- D. All duct smoke detectors shall be furnished by the Electrical Contractor, installed by the Sheet Metal Contractor and wired by the Electrical Contractor. See HVAC and electrical drawings for locations.
- E. Install fire, smoke, combination fire/smoke and control dampers.

3.5 TESTING

- A. For ductwork designed for 3 inches w.c. above ambient, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed.
1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
 2. Maximum Allowable Leakage: In accordance with ICC IECC.

END OF SECTION 23 31 00

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SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire dampers.
 - 2. Flexible duct connections.
 - 3. Balancing dampers.
 - 4. Duct access doors.
 - 5. Static pressure gauges.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. ASTM International:
 - 1. ASTM E1 - Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 92A - Recommended Practice for Smoke-Control Systems.
- D. Sheet Metal and Air Conditioning Contractors
 - 1. SMACNA – HVAC Duct Construction Standard – Metal and Flexible
- E. Underwriters Laboratories Inc.:
 - 1. UL 555 - Standard for Safety for Fire Dampers.
 - 2. UL 555C - Standard for Safety for Ceiling Dampers.
 - 3. UL 555S - Standard for Safety for Smoke Dampers.

1.4 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate for shop fabricated assemblies any item listed in 1.2 above.
- C. Product Data: Submit data for shop fabricated assemblies and hardware used.
- D. Product Data: Submit all items listed in 1.2 above. Include where applicable electrical characteristics and connection requirements.
- E. Product Data: For fire dampers, smoke dampers and combination fire and smoke dampers submit the following:
 - 1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
 - 2. Indicate materials, construction, dimensions, and installation details.
 - 3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- F. Manufacturer's Installation Instructions for all items.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 SUBSTITUTIONS

- A. Comply as applicable with Section 01 60 00 – Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.6 CLOSEOUT SUBMITTALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access doors and all damper types.
- C. Operation and Maintenance Data: Submit for all items listed in 1.2 above.

1.7 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

1.9 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Section 01 60 00 - Product Requirements: Product Storage and Handling Requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- D. Storage: Store materials in a dry area indoor, protected from damage.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.12 COORDINATION

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

1.13 WARRANTY

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for duct accessories.

1.14 EXTRA MATERIALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each size and type of fusible link.
- C. Furnish two of each size and type of dial thermometer.
- D. Furnish two of each size and type of static pressure gauges.

PART 2 PRODUCTS

2.1 FIRE DAMPERS

- A. Manufacturers
 - 1. Ruskin.
 - 2. Air Balance.
 - 3. Nailor.
- B. Model numbers are based on Ruskin to establish type and quality unless otherwise noted.
- C. Fire dampers shall be installed in fire partitions where shown on the drawings and elsewhere as required by NFPA Standard 90A and local codes. It is the responsibility of the Design Professional to locate fire dampers on the contract documents. Where a damper is inadvertently omitted in a contiguous wall and where adjacent ducts are shown to have fire dampers, it is the intent that all duct penetrations in the contiguous wall are to have fire dampers. At duct shaft wall penetrations, provide welded sleeve not rolled form type sleeve. Provide roll form sleeve at grille type installation (G style mount).
- D. Where fire dampers have been omitted in one hour fire rated walls in accordance with Exception No. 3 of the International Building Code, Section 716, all duct connections between the air handling unit and the air terminal device shall be sheet metal, minimum 26 gauge.
- E. Fire dampers shall be constructed in accordance with the requirements of UL 555 latest edition and shall bear UL label. Fire dampers shall have a 165 degrees F link. Dampers for use in a system with air temperatures above 110 degrees F shall have a 212 degrees F link. Fire dampers used in conjunction with an ATC damper for use in an engineered smoke control system shall have a 285 degrees F fusible link.
- F. Dampers shall be provided with factory sleeve and be of dynamic design for fan systems that do not shut down under smoke shut down control and static design for systems that do shut down under smoke shutdown control. Dampers pressure drop ratings shall be provided with submittals and shall be based on tests and procedures performed in accordance with AMCA 500.
- G. Dynamic fire dampers shall be of curtain style, up to the maximum size UL tested and rated single or multiple section assembly. Dampers shall be rated at 2000 fpm and 4 inch w.g. for closure. If the vendor cannot provide the dynamic damper in curtain style, then a multiblade style of fire damper shall be provided. If the opening size exceeds that for which a multiblade dynamic fire damper can be provided, then the vendor shall provide a combination fire-smoke damper with actuators as described in paragraph 2.3 and shall be responsible to inform the Design Professional, the contractor and shall coordinate power requirements for electrically operated dampers.
- H. Static fire dampers shall be of the curtain style, with blades out of airstream. Dampers shall be UL555 classified and labeled as a static fire damper for HVAC systems which shut down during a fire. Damper action shall be by gravity or spring closure upon fusible link release.
- I. Dampers with 1-1/2 hour rating shall be as follows:
 - 1. Dynamic Dampers

- a. Curtain Style
 - 1) Medium Pressure Ductwork DIBD2B
 - 2) Low Pressure Ductwork DIBD2B
 - 3) Low Pressure Ductwork with integral roll formed sleeve DIBD20
 - 4) Outside air louver and wall mounted registers and grilles DIBD2G
 - 5) For round ductwork use DIBD2CR
 - 6) For flat oval duct work use type DIBD2CO
 - b. When size exceeds maximum for curtain style (36 x 48), use Ruskin Model FD35 multiblade style dynamic fire damper. Sizes up to 36 x 48 vertical and 36 x 48 or 48 x 36 horizontal.
2. Static Dampers
- a. Low Pressure Ductwork 6 inches or less in depth IDB2B
 - b. Medium Pressure Ductwork IBD2B
 - c. Low Pressure Ductwork IBD2B
 - d. Low Pressure Ductwork with integral roll formed sleeve IBD20
 - e. Outside air louver and wall mounted registers and grilles IBD2B or IBD2G. If wall depth does not permit IBD2, type IBDT narrow frame model may be used.
 - f. For round ductwork use IBD2CR
 - g. Dampers installed out of wall shall be IBD2BOW
- J. All duct connections to dampers shall be breakaway style connections and shall conform to UL555 and NFPA90A and be installed per the manufacturers UL555 approved instructions specific to that model. Breakaway connections are not required where the duct size does not exceed 36 inches x 24 inches and sleeve material is 16 gauge galvanized or 14 gauge for sizes larger than 36 inches x 24 inches, per the manufacturers approved installation instructions. Shop drawings shall show UL approved damper installation.
- K. Prior to the installation of the fire dampers, the contractors shall submit shop drawings detailing the fire damper installation in accordance with the contract documents and NFPA90A and the manufacturers UL555 approved installation instructions. Failure to do so may result in corrective measures for dampers installed incorrectly.
- L. Dampers in fire rated floor/ceiling or roof/ceiling assemblies shall be Ruskin series CFD2, CFD 3, CFD 4, CFD 5, CFD 7 or CFD 8. Provide extensions, plenum boxes, insulation, supports, hangers, fusible adjustment thermal blankets as required
- M. Fire dampers shall be type "B" (blades out of airstream). Type "A" fire dampers (blades in airstream) may be used only if there are space restrictions and approved by the engineer. Mutliblade style dampers (Type "A") with blades in airstream shall be used when sizes required exceed maximum size available as "B" style.
- N. Refer to manufacturer's guidelines & details for field-applied sealant, as required by local codes.

2.2 FLEXIBLE CONNECTIONS

- A. Flexible connection shall be provided between the suction and discharge openings in fan housings and the ducts with which they are connected. Flexible connectors shall be Ductmate Proflex, Duro-Dyne,

Metal-Fab, or approved equal with 3 inch metal ends joined with "Grip Loc" seam to 3 inch neoprene fabric. Provide VentFabric Ventlon flexible connections for exterior use and shall be UV rated. Fabric shall be UL listed and shall meet NFPA 90A. Assembly in complete accord with the manufacturer's recommendations.

2.3 BALANCING DAMPERS

- A. Manufacturers
 - 1. Duro Dyne.
 - 2. Ruskin.
 - 3. Air Balance.
- B. Model numbers are based on Duro Dyne and Ruskin to establish type and quality unless otherwise noted.
- C. Balancing dampers shall be installed in ducts in all branches from mains and risers, and in the branches to outlet and inlet grille openings. Volume dampers in diffuser necks are specified with the diffusers elsewhere in the specification. Except where located close behind grilles or fire dampers and except where other dampers are specified, volume dampers in ducts 12 inches or less in depth shall be single leaf type. Dampers in ducts having a depth more than 12 inches and dampers located close behind grilles and fire dampers, shall be multiple opposed blade type. Blades of multiple dampers shall be of widths to suit the space limitations, but not more than 6 inches wide. Except as otherwise specified herein, dampers shall have external adjusting quadrants. Where ducts are insulated, the quadrants shall be blocked out on zinc-coated steel support finishing flush with insulation.
- D. The drawings generally do not indicate the volume dampers; they shall be installed in all locations required as specified above. Splitter type volume dampers shall not be used. All volume dampers shall be constructed of zinc-coated steel two gauge numbers heavier than the duct in which they are installed and shall be reinforced for stiffness so as to be free of noise and vibration if in any position. Dampers shall be rigidly and permanently attached to their shafts.
- E. Regulators shall be Ruskin, Air Balance or approved equal to Duro Dyne No. SR or SRST, and bearings shall be closed end No. SB or approved equal.
- F. Submit data sheets for approval.
- G. Damper quadrants shall be Duro Dyne Model 8063.
- H. Dampers shall be Ruskin MD25, MD35, MDRS26, MDRS27, CD36, CD40, CD50, or CDRS25.
- I. Remote Balancing Dampers:
 - 1. Air balancing dampers at inaccessible locations such as above gypboard ceilings and at elevation above 12 feet 0 inches shall be provided with an approved mechanism for remote adjustment. Ceiling access doors for balancing damper access above hard ceilings shall not be allowed without prior approval of the Architect. The adjustment mechanism shall be a cable control system by Young Regulator Company or approved equal Model 270-896 or 270-315 with associated damper Model 5020-CC or 830A-CC to meet project conditions.
 - 2. Remote balancing dampers shall be provided where indicated on the Air Outlets and Labels Schedule on the drawings.

2.4 ACCESS DOORS

- A. Manufacturers
 - 1. Ruskin.
 - 2. Kees.
- B. Model numbers are based on Ruskin to establish type and quality unless otherwise noted.
- C. Provide access doors in ductwork as indicated, specified elsewhere and as required to maintain internal devices and provide inspection. Access doors shall be of the following types:
 - 1. Access doors 24 inches x 24 inches and smaller shall be Model ADC (cam) or ADH (hinged) as follows:
 - a. Doors shall be 20 gauge galvanized steel construction and frame with neoprene gasket seal.
 - b. Doors shall be constructed with removable single skin, removable double skin, hinged single skin or hinged double skin as indicated in Paragraph 3.2.
 - c. Cam access doors 16 inches and under shall have two locks and doors over 16 inches shall have four locks.
 - d. Hinged doors shall have a continuous piano type hinge. Doors 16 inches and below shall have one lock and doors over 16 inches shall have two locks.
 - e. Double skin access doors shall have been tested to 8 inches w.g. and shall have 1 inch thick fiberglass. Doors shall be rated for duct system they are installed in but not less than the system fan static pressure.
 - f. Provide the following accessories:
 - 1) Security chain
 - 2. Access doors of sizes greater than 24 x 24 shall be model GPAD as follows:
 - a. Frame shall be heavy duty extruded aluminum with nominal 1½ inch front flanges and mitered comers.
 - b. Doors shall have extruded aluminum frame with mitered comers and 24 gauge galvanized steel panels.
 - c. Provide two dual acting handles for doors 48 inches high and smaller and three dual acting handles for doors over 48 inches high.
 - d. Doors shall have a continuous piano type hinge, neoprene sponge seal, 3/4 inches thick urethane foam board insulation with an "R" value of 5.5, and a mill finish.
 - e. Doors shall have a leakage rate of 0.1 cfm/perimeter inch when closed.
 - f. Doors shall be tested to 4 inches positive and 8 inches w.g. negative pressure. Doors shall be rated for duct system they are installed in but not less than the system fan static pressure.

2.5 STATIC PRESSURE GAUGES

- A. Manufacturers
 - 1. Dwyer.
 - 2. Weiss.
 - 3. Ashcroft.
 - 4. Trerice.

5. Weksler.
- B. Model numbers are based on Dwyer to establish type and quality unless otherwise noted.
- C. Pressure gauges shall be Dwyer Series 2000 and shall have a diecast aluminum case and bezel with acrylic cover, zero adjustment screw with "O" ring seal, and restricted silicone rubber diaphragm with integrally molded "O" ring supported by front and rear plates. Exterior finish shall withstand 168 Hove salt spray corrosion test.
 1. Gauges shall be 4 inches in diameter dial face with ± 2 percent of full scale accuracy.
 2. Mounting orientation shall have diaphragm in vertical position. Provide relief plug to prevent overpressurization.
 3. Provide two 1/8 inch NPT plugs for duplicate pressure taps, two 1/8 inch pipe thread to rubber tubing adapter and three flush mounting adapters with screws.
 4. Gauges shall be in inches of water with a range of (0-1) (1-0-1) (0-2) (2-0-2) (0-5) (5-0-5) (0-10) (10-0-10) or as required to indicate system pressure with normal operating pressure indicated within the middle third of the scale.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Coordinate with Section 01 30 00 - Administrative Requirements: Coordination and Project Conditions.
- B. Verify rated walls are ready for fire damper installation.
- C. Verify ducts and equipment installation are ready for accessories.
- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement

3.2 INSTALLATION

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated on Drawings.
- C. Access Doors: Install access doors at the following locations and as indicated on Drawings:
 1. Spaced every 50 feet of straight duct for cleaning.
 2. Base of duct risers.
 3. Before and after each duct mounted coil.
 4. Before and after each duct mounted fan.
 5. Before and after each automatic control damper.
 6. Before and after each fire damper and combination fire and smoke damper.
 7. Downstream of each VAV, CV and FPU box.
- D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

1. Mark access doors for fire and smoke dampers on outside surface, with minimum 1/2 inch high letters reading: FIRE/SMOKE DAMPER OR FIRE DAMPER.
 2. Single wall ductwork shall be provided with single wall access doors, removable type, up to 12 x 12 and hinged type for doors larger than 12 x 12.
 3. Double wall ductwork and lined ductwork shall be provided with double skin access doors, removable type, up to 12 x 12 and hinged type for doors larger than 12 x 12.
- E. Install fire dampers and combination fire and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
1. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A, manufacturer's recommendations, and local codes.
 2. Install dampers square and free from racking with blades running horizontally.
 3. Do not compress or stretch damper frame into duct or opening.
 4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
 5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.3 INSTALLATION - STATIC PRESSURE GAUGES

- A. Install static pressure gauges to measure across filters and filter banks, (inlet to outlet). On multiple banks, provide manifold and single gauge.
- B. Provide instruments with scale ranges selected according to service with largest appropriate scale.

3.4 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION 23 3300

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SECTION 23 34 00 – HVAC FANS, VENTILATORS, AND ACCESSORIES

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SECTION 233400 – HVAC FANS, VENTILATORS, AND ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Ceiling and Cabinet Fans
 - 2. Roof downblast centrifugal exhaust fans.
- B. Related Sections:
 - 1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
 - 2. Section 23 07 00 - HVAC Insulation: Product requirements for power ventilators for placement by this section.
 - 3. Section 23 09 00 – HVAC Instrumentation and Controls: Controls remote from unit.
 - 4. Section 23 31 00 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
 - 5. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 - Standards Handbook.
 - 2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
 - 3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 - 5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- C. American Refrigeration Institute:
 - 1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.

- D. ASTM International:
 - 1. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- E. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. Underwriters Laboratories Inc.:
 - 1. UL 705 - Power Ventilators.

1.4 PERFORMANCE REQUIREMENTS

- A. Coordinate wind loads with Section 23 05 47 Vibration Controls for HVAC Piping and Equipment.

1.5 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 SUBSTITUTIONS

- A. Comply as applicable with Section 01 60 00 – Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.7 CLOSEOUT SUBMITTALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.8 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 [and bear AMCA Certified Rating Seal.]
- B. Sound Ratings: AMCA 301, tested to AMCA 300 [and bear AMCA Certified Sound Rating Seal.]
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

- D. Balance Quality: Conform to AMCA 204.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.10 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect motors, shafts, and bearings from weather and construction dust.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.13 WARRANTY

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer's warranty for fans.

1.14 MAINTENANCE SERVICE

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Furnish service and maintenance of fans for one year from Date of Substantial Completion.
- C. Examine each fan components semi-annually. Clean, adjust, and lubricate equipment as required per the manufacturers operation and maintenance manual.
- D. Include systematic examination, adjustment, and lubrication of fans, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- E. Perform work without removing fans from service during building normal occupied hours. Coordinate with building owner for work after normal occupied hours.
- F. Provide emergency call back service at all hours during working hours for this maintenance period.

- G. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- H. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.
- I. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.15 EXTRA MATERIALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of belts for each fan.

PART 2 PRODUCTS

2.1 CEILING AND CABINET FANS

- A. Manufacturers:
 - 1. Greenheck Corp. Model SP and CSP.
 - 2. Penn Barry Model ZEPHYR.
 - 3. Loren Cook Company Model GEMINI.
- B. Model numbers are based on Greenheck to establish type and quality unless otherwise noted.
- C. Housing:
 - 1. Shall be constructed of heavy gauge galvanized steel lined with 1/2 inch acoustical insulation.
 - 2. The outlet duct collar shall include an aluminum gravity or spring loaded backdraft damper.
 - 3. Unit shall have a permanently affixed manufacturer's nameplate indicating the model and serial number.
- D. Fan Wheel:
 - 1. Fan wheel shall be polypropylene forward curve centrifugal type statically and dynamically balanced in accordance with AMCA standards.
- E. Inlet Grille:
 - 1. Where noted on schedule, aluminum grill type shall be white enamel finish on SP Models A50 thru A390.
- F. Motors:
 - 1. Motor enclosures shall be open drip-proof ODP with thermal overload protection.
 - 2. Motors shall be permanently lubricated sleeve bearing type to match the fan load and finished at the specified voltage and phase.
 - 3. Motors shall be mounted on vibration isolators, be accessible for maintenance and compatible for use with speed controls.
- G. Accessories:
 - 1. Provide solid state speed controller shipped loose rated at 15 amps.

2. Refer to schedule on drawings for additional accessories.

2.2 ROOF DOWNBLAST CENTRIFUGAL EXHAUST FANS

- A. Manufacturer
 1. Greenheck.
- B. Direct Drive Roof Downblast Centrifugal Exhaust Fans - Greenheck Model G
 1. General Description:
 - a. Downblast fan shall be for roof mounted applications.
 - b. Performance and options shall be as scheduled on the drawings.
 - c. Maximum continuous operating temperature is 180 Fahrenheit (82.2 Celsius).
 - d. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number.
 2. Wheel:
 - a. Constructed of aluminum.
 - b. Non-overloading, backward inclined centrifugal.
 - c. Statically and dynamically balanced in accordance to AMCA Standard 204-05.
 - d. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.
 3. Motors:
 - a. Electronically Commutated Motor:
 - 1) Motor enclosures: Open type.
 - 2) Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications.
 - 3) Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.
 - 4) Internal motor circuitry to convert AC power supplied by fan to DC power to operate motor.
 - 5) Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor.
 - 6) Motor shall be a minimum of 85% efficient at all speeds.
 4. Housing:
 - a. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum.
 - b. Shroud shall have an integral rolled bead for extra strength.
 - c. Shroud shall be drawn from a disc and direct air downward.
 - d. Lower windband shall have a formed edge for added strength.
 - e. Motor cover shall be drawn from a disc.

- f. All housing components shall have final thicknesses equal to or greater than preformed thickness.
 - g. Curb cap shall have pre-punched mounting holes to ensure correct attachment.
 - h. Rigid internal support structure.
 - i. Leak proof.
5. Housing Supports and Drive Frame:
- a. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
6. Vibration Isolation:
- a. Rubber isolators.
 - b. Sized to match the weight of each fan.
7. Disconnect Switches:
- a. NEMA 3R: outdoor application falling rain water.
 - b. Positive electrical shut-off.
 - c. Wired from fan motor to junction box installed within motor compartment.
8. Options/Accessories:
- a. Birdscreen:
 - 1) Material Type: Galvanized.
 - 2) Protects fan discharge.
 - b. Roof Curbs:
 - 1) Roof Curbs shall be Greenheck GPI- Welded, straight sided curb with 2 inches of flashing flange and wood nailer, curbs shall be 18" high.
 - 2) Mounted onto roof with fan.
 - 3) Material: Galvanized.
 - 4) Coating Type: None.
 - c. Curb Seal:
 - 1) Rubber seal between fans and the roof curb.
 - d. Dampers:
 - 1) Type: Motorized.
 - 2) Prevents outside air from entering back into the building when fan is off.
 - 3) Balanced for minimal resistance to flow.
 - 4) Galvanized frames with prepunched mounting holes.
 - e. Hinge kit:
 - 1) Aluminum hinges.
 - 2) Allows the fan to tilt away for access to wheel and ductwork for inspection and cleaning.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including technical bulletins and product catalog installation instructions.
- B. Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 EXAMINATION

- A. Comply as applicable with Section 01 03 00 – Administrative Requirements: Coordination and Project Conditions

3.3 PREPARATION

- A. Ensure openings are square, accurately aligned, correctly located and in tolerance.
- B. Ensure duct is plumb, sized correctly and to proper elevation. Install duct as specified in Air Distribution – Division 23.

3.4 INSTALLATION

- A. Secure roof curbs and fans with cadmium plated steel lag screws to structure.
- B. Provide sheaves required for final air balance.
- C. Suspended cabinet fans: Install flexible connections specified in Section 23 33 00 – Air Duct Accessories between each fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- D. Install fan system as indicated on the installation, Operation and Maintenance Manual (IOM) and contract drawings.
- E. Install fans in accordance with manufacturer's instructions.
- F. System startup shall be per Installation, Operation, and Maintenance Manual (IOM).
- G. Adjusting:
 - 1. Adjust fans to function properly.
 - 2. Adjust Belt Tension.
 - 3. Lubricate bearings.
 - 4. Adjust drive for final system balancing.
 - 5. Check wheel overlap.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Comply as applicable with Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

- B. Furnish services of factory trained representative for minimum of three days to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean inside of fan cabinet.
- C. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction.

3.7 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate fan operation and maintenance procedures.

3.8 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect installed product and finished surfaces from damage during construction.
- C. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion.
- D. Do not operate fans until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

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SECTION 23 36 00 – AIR TERMINAL UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single duct constant and variable volume terminal units.
- B. Related Sections:
 - 1. Section 23 09 00 - HVAC Instrumentation and Controls: Controls remote from unit.
 - 2. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electrical connections to air terminal units specified by this section.

1.3 REFERENCES

- A. American Refrigeration Institute:
 - 1. ARI 880 - Air Terminals.
 - 2. ARI 885 -Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- D. Underwriters Laboratories Inc.:
 - 1. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings indicating airflow, static pressure, heating coil capacity and NC designation. Include electrical characteristics and connection requirements. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 inch to 4 inches wg.
- C. Manufacturer's Installation Instructions: Submit support and hanging details, and service clearances required.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 SUBSTITUTIONS

- A. Comply as applicable with Section 01 60 00 – Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC

1.6 CLOSEOUT SUBMITTALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of units and control components.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.7 QUALITY ASSURANCE

- A. Test and rate air terminal units' performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 COORDINATION

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with 25 09 23 – Direct Digital Control System for HVAC.

1.12 WARRANTY

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for air terminal units.

1.13 EXTRA MATERIALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.

PART 2 PRODUCTS

2.1 SINGLE DUCT CONSTANT AND VARIABLE VOLUME AIR TERMINAL UNITS

- A. Manufacturers
 - 1. Titus.
 - 2. Anemostat.
 - 3. Kruger
- B. Model numbers are based on Titus to establish type and quality unless otherwise noted.
- C. Furnish and install TITUS Model DESV single duct, variable air volume terminals of the sizes and capacities shown in the plans.
- D. Terminals shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal. Noncertified terminals may be submitted after testing at an independent testing laboratory under conditions selected by the engineering consultant in full compliance with ARI Standard 880. These tests must be witnessed by the engineering consultant with all costs to be borne by the terminal manufacturer. Testing does not ensure acceptance.
- E. The terminal casing shall be minimum 22-gauge galvanized steel, internally lined with engineered polymer foam insulation which complies to UL181 and NFPA 90A. Insulation shall be 1½ pound density, closed cell foam. Exposed fiberglass is not acceptable. The insulation shall be mechanically fastened to the unit casing. The casing shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.

- F. The damper shall be heavy gauge steel with shaft rotating in Delrin® self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.
- G. Actuators shall be capable of supplying at least 35-inch lbs. of torque to the damper shaft and shall be mounted externally for service access. Terminals with internal actuator mounting or linkage connection must include gasketed access panel, removable without disturbing ductwork. Casing with access panel shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.
- H. At an inlet velocity of 2000 fpm, the minimum static pressure required to operate any terminal size shall not exceed 0.13-inch wg for the basic terminal.
- I. Sound ratings for the terminal shall not exceed 30 NC at 0.8 static pressure. Sound performance shall be ARI certified.
- J. Standard SCR Electric Heat
1. Proportional, modulating electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be ETL listed. Coils shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5 inches to prevent damage to elements during shipping and installation. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3.5 inches apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.
 2. Electric coils shall contain a primary automatic reset thermal cutout, a secondary manual reset thermal cutout, proportional electronic airflow sensor for proof of flow, and line terminal block.
The proportional electronic airflow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available airflow. The heaters shall deliver maximum heating when needed with normal minimum airflow, reduce heating with lower than minimum airflow and stop heating with no airflow. Unit shall include an integral door interlock type disconnect switch which will not allow the access door to be opened while power is on. Non-interlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.
 3. Heaters shall be equipped with a proportional SCR controller to modulate the heater load according to the temperature control signal. The electronic controller shall be compatible with the following input signals:
 - Variable voltage signal 0-10 VDC
 - Pulse width modulation AC or DC
- K. Where indicated in the schedules, provide a 22-gauge galvanized steel attenuator to the discharge of the terminal unit. Attenuator shall have a 1-inch glass fiber internal acoustic liner to match box construction. Unit shall have been tested in accordance with ARI 880 Standard. Provide slip and drive or flanged connections to the site project requirements.

L. OEM Controls Program

1. The terminals shall be equipped with pressure independent direct digital controls supplied and mounted by the terminal unit manufacturer to be commissioned in the field by the control's contractor.
2. Controls shall be compatible with pneumatic inlet velocity sensors supplied by the terminal manufacturer. The sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of 0.03wg. at an inlet velocity of 500 fpm.
3. Controls shall be factory set for unit size and the scheduled minimum and maximum flow rates. Controls shall be field addressed by the control's contractor. All pneumatic tubing shall be UL listed fire retardant (FR) type. Each terminal shall be equipped with labeling showing unit location, size, and scheduled cfm.
4. The terminal manufacturer shall provide a Class II 24 Vac transformer and disconnect switch. Actuator shall be direct connection shaft mount type without linkage. All controls shall be installed in approved NEMA1 sheet metal enclosure by terminal manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify ductwork is ready for air terminal installation.

3.2 INSTALLATION

- A. Connect to ductwork in accordance with Section 23 31 00.
- B. Install ceiling access doors or locate units above easily removable ceiling components.
- C. Support units individually from structure. Do not support from adjacent ductwork.
- D. Support air terminal units connected by flexible duct independently of flexible duct.
- E. Install transition piece to match flexible duct size to inlet or outlet of variable air volume terminal.

3.3 ADJUSTING

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Comply as applicable with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC.

END OF SECTION 23 36 00

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SECTION 233700 - AIR OUTLETS AND INLETS

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SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Diffusers.
 - 2. Registers
 - 3. Grilles.
 - 4. Brick Vent.
- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating: Execution and product requirements for Painting of ductwork visible behind outlets and inlets specified by this section.
 - 2. Section 23 33 00 - Air Duct Accessories: Volume dampers for inlets and outlets.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Samples: Submit two of each required air outlet and inlet type.
- D. Test Reports: Rating of air outlet and inlet performance.

- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- 1.5 SUBSTITUTIONS
 - A. Comply as applicable with Section 01 60 00 – Product Requirements.
 - B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.
- 1.6 CLOSEOUT SUBMITTALS
 - A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
 - B. Project Record Documents: Record actual locations of air outlets and inlets.
- 1.7 QUALITY ASSURANCE
 - A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
 - B. Test and rate louver performance in accordance with AMCA 500.
- 1.8 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience, and with service facilities within 100 miles of Project.
- 1.9 PRE-INSTALLATION MEETINGS
 - A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
 - B. Convene minimum one week prior to commencing work of this section.
- 1.10 WARRANTY
 - A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
 - B. Furnish one year manufacturer warranty for air outlets and inlets.
- 1.11 EXTRA MATERIALS
 - A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS

- A. Each supply, return, and/or exhaust termination shall be provided with a grille, register or diffuser that is compatible with the type of ceiling construction in which installed.
- B. All grilles, registers, and diffusers shall be as specified below and shall be primed and painted matte white unless otherwise noted below.
- C. The sound power level of these devices shall be such that the sound level shall not exceed acceptable levels for the intended occupancy per ASHRAE.
- D. Grilles, registers and diffusers shall be constructed of steel or aluminum as specified.

2.2 MANUFACTURERS

- 1. Titus.
- 2. Tuttle and Bailey.
- 3. EH Price.
- 4. Anemostat Air Product.

2.3 MODEL NUMBERS

- A. Model numbers are based on Titus to establish type and quality unless otherwise noted. Refer to schedule on drawings.

2.4 BRICK VENT

- A. Brick Vent shall be manufactured by Greenheck or equal as indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

3.2 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 90 00.
- D. Do not locate air registers, diffusers or grilles in floors of toilet or bathing rooms.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION 233700

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SECTION 23 73 00 – PACKAGED ROOFTOP HEATING AND COOLING UNITS AND PACKAGED ROOFTOP MAKE-UP AIR UNIT WITH DIRECT GAS-FIRED FURNACE AND COOLING

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SECTION 23 73 00 – PACKAGED ROOFTOP HEATING AND COOLING UNITS AND PACKAGED ROOFTOP MAKE-UP AIR UNIT WITH DIRECT GAS-FIRED FURNACE AND COOLING

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Packaged Rooftop Heating and Cooling Units (RTU – 1 and 2)
- B. Related Sections:
 - 1. Section 23 05 00 – Common Work Results for HVAC.
 - 2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
 - 3. Section 23 07 00 - HVAC Insulation: Product requirements for insulation for placement by this section.
 - 4. Section 23 09 00 - HVAC Instrumentation and Controls: Controls remote from unit.
 - 5. Section 23 33 00 - Air Duct Accessories: Product requirements for flexible duct connections for placement by this section.
 - 6. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
 - 7. Section 26 29 23 - Variable-Frequency Motor Controllers: Variable frequency controllers.

1.3 REFERENCES

- A. American Bearing Manufacturers Association:
 - ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 - Standards Handbook.
 - AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 - AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

- C. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
 - ARI 430 - Central-Station Air-Handling Units.
 - ARI 610 - Central System Humidifiers for Residential Applications.
 - ARI Guideline D - Application and Installation of Central Station Air-Handling Units.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- E. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- F. Underwriters Laboratories Inc.:
 - 1. UL 900 - Air Filter Units.
 - UL - Fire Resistance Directory.
- G. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration. (all)
- H. ANSI/ASHRAE/IESNA 90.1-2013 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.
- I. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.
- J. ANSI/NFPA 70-1995 - National Electric Code. (all)
- K. International Fuel Gas Code (g/e)
- L. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems. (all)

1.4 SUBMITTALS

- A. Comply as applicable with Section 01 30 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- C. Product Data, Submit the following:
 - Published Literature: Indicate capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
 - Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
 - Fans: Performance and fan curves with specified operating point plotted, power, RPM.
 - Sound Power Level Data: Fan discharge and casing radiation at rated capacity.
 - Dampers: Include leakage, pressure drop, and sample calibration curves. Indicate materials, construction, dimensions, and installation details.
 - Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring. Indicate factory installed and field installed wiring.
- D. Manufacturer's Installation Instructions: Submit.

- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 SUBSTITUTIONS

- A. Comply as applicable with Section 01 60 00 – Product Requirements.
- B. Comply as applicable with Section 23 05 00 – Common Work Results for HVAC.

1.6 CLOSEOUT SUBMITTALS

Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

Operation and Maintenance Data: Submit instructions for lubrication, filter replacement, motor and drive replacement, energy and heat wheel maintenance, spare parts lists, and wiring diagrams.

1.7 QUALITY ASSURANCE

- A. Outside Air Damper Leakage: Test in accordance with AMCA 500.
- B. Refer to specification Section 23 05 00 for restrictions on early use of HVAC equipment.
- C. Unit shall be rated in accordance with AHRI (Air-Conditioning, Heating and Refrigeration Institute) Standard 340/360, latest edition.
- D. Unit shall be designed to conform to ANSI (American National Standards Institute)/ASHRAE (American Society of Heating, Refrigerating and Air- Conditioning Engineers) 15 (latest edition), ASHRAE 62, and UL Standard 1995.
- E. Unit shall be listed by ETL and ETL, Canada, as a total package.
- F. Unit shall be designed to conform to ANSI Standard Z21.47 (U.S.A.)/CSA Standard 2.3 (Canada), Gas-Fired Central Furnaces.
- G. Roof curb shall be designed to NRCA (National Roofing Contractors Association) criteria per Guideline B-1986.
- H. Insulation and adhesive shall meet NFPA (National Fire Protection Association) 90A requirements for flame spread and smoke generation.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum five years documented experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Protect units from weather and construction traffic by storing in dry, roofed location.

1.11 WARRANTY

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Provide parts and labor warranty extending either 12-months from the date of unit start-up or a maximum of 18-months from unit ship date.
- C. Provide ten-year warranty for rooftop units.
- D. 5 year compressor parts and labor warranty.

1.12 REGULATORY REQUIREMENTS

- A. Unit shall conform to the appropriate standards listed in Section 103 as well as be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) for compliance with the following applicable standards.
 - 1. Standard for Safety Heating and Cooling Equipment-Fourth Edition, UL 1995/CSA C22.2#236 Issue: 2011/10/14
 - 2. Standard for Gas Unit Heaters And Gas-Fired Duct Furnaces ANSI Z83.8-2013, CSA 2.6-2013, Third Edition – 2006
 - 3. Standard for Non-Recirculating Direct Gas-Fired Industrial Air Heaters, ANSI Z83.4 / CSA 3.7 - Issued: 2013/03/01 Ed: 3
 - 4. In the event the unit is not approved by an NRTL for compliance with the appropriate standards, the manufacturer shall, at manufacturer's expense, provide for a field certification and labeling of unit by an NRTL to the appropriate standards. Manufacturer shall, at manufacturer's cost, complete any and all modifications required by NRTL prior to certification and field labeling. Manufacturer shall include coverage of all modifications in unit warranty.

1.13 EXTRA MATERIALS

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of fan belts for each unit.
- C. Furnish one set of filters for each unit.

PART 2 PRODUCTS

2.1 PACKAGED ROOFTOP UNITS

- A. Manufacturers: Products shall be provided by the following manufacturers
 - 1. Johnson Controls, Inc. – Choice
 - 2. Carrier Corporation
 - 3. Daikin US Corporation
- B. General Description
 - 1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, exhaust fans, energy recovery wheels, and unit controls.
 - 2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
 - 3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - 4. Unit components shall be labeled, including refrigeration system components, and electrical and controls components.
 - 5. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 - 6. Installation, Operation, and Maintenance manual shall be supplied within the unit.
 - 7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 - 8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

2.2 HVAC EQUIPMENT INSULATION

- A. Gas heat and economizer and control compartments:
 - 1. Evaporator Fan:
 - a) Interior cabinet surfaces shall be insulated with a minimum 0.5 in. thick, fiber glass insulation with thermal conductivity of 0.23 or better, adhered with water based adhesive.
 - b) Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- B. Partition and Duct Panel, Base Pan and Blower Back:
 - 1. Interior cabinet surfaces shall be insulated with a minimum 0.5 in. thick, fiber glass insulation with thermal conductivity of 0.23 or better, adhered with water based adhesive.

2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

2.3 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

- A. Packaged rooftop units (RTU's) shall have self-contained controls that can be enabled and classified through the Direct Digital Control Building Automation System (DDC BAS) as follows:
 - Capable to energize 4 different stages of cooling and modulating heating.
 - Capable for occupancy scheduling.
- B. Simplicity SMART Equipment Control
 1. Shall be ASHRAE 62 compliant.
 2. Shall accept 20-30 VAC input power, 50/60Hz. 24 VAC nominal.
 3. Shall have an operating temperature range from -40°F to 158°F; 10-90% RH (non-condensing UI), and -4°F to 158°F; 10-90% RH (non-condensing), with a storage temperature range from -40°F to 194°F; 5-95% RH (non-condensing).
 4. Shall include an Economizer microprocessor controller which communicates directly with the Unit Control Board and has 8 Analog outputs, 2 Analog inputs, 2 Binary outputs, 3 Binary inputs.
 5. Controller shall accept the following inputs: space temperature, return air temperature sensor, set point adjustment, outdoor air temperature, indoor air quality, outdoor air quality, return air relative humidity, compressor lock-out, fire/smoke shutdown, single and dual enthalpy, fan status, remote time clock, Sensor Actuator (SA) Bus communicated temperature/humidity/CO2 values from Network sensors, Field Controller (FC) Bus Network Overrides for space temperature, outdoor air temperature, space humidity, outdoor air quality, Indoor air quality, System purge.
 6. Shall accept a CO₂ sensor or multiple CO₂ sensors networked together in the conditioned space, and be Demand Control Ventilation (DCV) ready.
 7. Shall provide compressor short-cycle protection with minimum compressor runtime set at 3 minutes standard and adjustable from 2 to 7 minutes.
 8. Unit shall provide surge protection for the controller through a circuit breaker.
 9. Shall have open communication protocols with all required points exposed. Protocols supported include: BACNet MS/TP, Modbus and N2 Communications..
 10. Shall have an LCD display on the Unit Control Board to display fault messages as well as navigate the menu structure to review and change set points.
 11. Shall utilize a USB connection to allow for uploading and downloading of data.
 - a. USB shall allow for downloading of "trending data" for analysis of inputs and values on other device such as a PC.
 - b. USB shall allow for uploading of new firmware to the UCB.
 - c. USB shall allow for backing up controller set points and parameters and for uploading of these same parameters to the UCB.
 12. Shall include an RJ-12 port to be used with a Wi-Fi signal transmitting device and allow unit(s) access via any non-proprietary smart device.
 - a. Unit access shall include ability to view and change all adjustable parameters and set points using the same characteristics and values available directly through the UCB joystick and LCD display.
 - b. Unit access shall be configurable at 3 different levels to allow control over parameter and set point changes.
 - c. Wi-Fi transmitting device can be connected by 3 means.

- i. RJ-12 port connected directly to UCB.
 - ii. Optional connection port mounted in operating space.
 - iii. Optional connection to building network allowing unit access from any internet browser worldwide.
 - 13. Shall have the capability to integrate with zoning controls system
 - 14. Shall not require any proprietary software or contractor tool to start-up, commission and troubleshoot unit operation.
 - 15. Software upgrades will be accomplished by local download via USB port on main Unit Control Board.
 - 16. Shall be UL Recognized, File E107041, UL 916, Energy management Equipment, UL 60335-2-40, Heating and Cooling Equipment; FCC Compliant to CFR47, Part 15, Subpart B, Class B, CSA 22.2 No. 236, Signal Equipment Industry Canada, ICES-003 Recognized, and BTL certified.
- C. Electric and Electronic Control System for HVAC
- 1. Shall be complete with self- contained low- voltage control circuit protected by a resettable circuit breaker on the 24- v transformer side. Transformer shall have minimum 75VA capability.
 - 2. Shall utilize color- coded wiring.
 - 3. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low and high pressure switches.
 - 4. The gas furnace shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.
- D. Safeties
- 1. Compressor over- temperature and over- current.
 - 2. Low pressure switch and high pressure switch
 - 3. Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
 - 4. Automatic reset, motor thermal overload protector.
 - 5. Gas heating section shall be provided with the following minimum protections:
 - a. Primary and auxiliary high temperature limit switches.
 - b. Induced draft pressure sensor.
 - c. Flame rollout switch.
 - d. Flame proving controls.
 - 6. Electric heat section shall be provided with the following minimum protections:
 - a. Primary, backup and auxiliary high temperature limit switches

2.4 PANEL AIR FILTERS

- A. Shall consist of factory installed, low velocity, disposable 2- in. thick fiberglass filters of commercially available sizes.
- B. Units can accept 2" or 4" filters and have a field convertible transition.
- C. Filters shall be accessible through an access panel; hinged panel with toolless access is available as described in the Special Features Options and Accessories section of this specification.

2.5 UNIT CABINET

- A. Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 750 hour salt spray test per ASTM-B117 standards.
- B. Unit cabinet exterior paint shall be: film thickness, (dry) 3.0 MILS minimum, gloss (per ASTM D523, 60°F / 16°C): 80+/-5, Hardness: H- 2H Pencil hardness.
- C. Unit cabinet shall have gas utility entry holes in the side of the unit and in the unit underside. Entry holes shall not require field setup and shall be capped from the factory to prevent water intrusion when not in use.
- D. Unit cabinet shall have electric utility entry locations marked from the factory with a dimple for accuracy of field drilling. Entry locations shall be available for entry through the side of the unit or from the unit underside.
- E. Base Rail
 - 1. Unit shall have base rails on all 4 sides.
 - 2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
 - 3. Holes shall be provided in the base rail for moving the unit by fork truck.
 - 4. Base rail shall be a minimum of 15 gauge thickness.
- F. Condensate pan and connections:
 - 1. Shall be a multidirectional internally sloped condensate drain pan made of a non- corrosive material.
 - 2. Shall comply with ASHRAE Standard 62.
 - 3. Shall use a 1" NPT female drain connection through the side of the drain pan. Connection shall be made per manufacturer's recommendations.
 - 4. Shall include intentional "overflow notch" and water containment path to guide flow of water where desired in the event of a drain pan overflow.
- G. Top panel:
 - 1. Shall be a multi piece top panel.
- H. Electrical Connections
 - 1. All unit power wiring shall enter unit cabinet through a field drilled hole located by a factory provided dimple.
 - 2. Through- the- base capability.
 - 1. Standard unit shall have a through- the- base electrical location(s) using a raised, embossed portion of the unit base-pan.
 - 2. No base-pan penetration, other than those authorized by the manufacturer, is permitted.

2.6 GAS HEAT

- A. General
 - 1. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
 - 2. Shall incorporate a direct- spark ignition system and redundant main gas valve.

3. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
 4. Burners shall be of the in- shot type constructed of aluminum- coated steel.
 5. Burners shall incorporate orifices for rated heat output up to 2000 ft. (610m) elevation. Additional accessory kits may be required for applications above 2000 ft. (610m) elevation, depending on local gas supply conditions.
 6. Each heat exchanger tube shall contain multiple dimples for increased heating effectiveness.
- B. The gas furnace shall be controlled by an integrated gas controller (IGC) microprocessor.
1. IGC board shall notify users of fault using an LED (light- emitting diode).
 2. Unit shall be equipped with anti- cycle protection with one cycle on the unit flame rollout switch, 3 short cycles on the high temperature limit switch, one cycle on the auxiliary limit switch, and one cycle on indoor blower fault detection. Fault indication shall be made using an LED.
- C. Modulating gas heat
1. Shall modulate flow of gas through to furnace to allow for incremental change of heating capacity, with capability of adjusting by as little as 1%.
 2. Shall have a turndown ratio of 2.85 to 1.
 3. Heat exchangers shall be of stainless steel construction
- D. Stainless Steel Heat Exchanger construction
1. The optional stainless steel heat exchanger shall be of the tubular- section type, constructed of a minimum of 20- gauge type 409 stainless steel.
 2. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.
- E. Induced draft combustion motor and blower
1. Shall be a direct- drive, single inlet, forward- curved centrifugal type.
 2. Shall be made from steel with a corrosion- resistant finish.
 3. Shall have permanently lubricated sealed bearings.
 4. Shall have inherent thermal overload protection with automatic reset feature.

2.7 COILS

- A. Evaporator Coils, Aluminum Fin - Copper Tube:
1. Standard evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
 2. Shall be leak tested to 150 psig, pressure tested to 250 psig, and burst qualified to CSA C22.2 No. 60335-2-40.
 3. Assembled unit shall be pressure tested to 450 psig.
- B. Condenser Coils, All Aluminum Microchannel:
1. Condenser coils shall have all aluminum microchannel design consisting of aluminum multiport flat tube design and aluminum fin. Coils shall be a furnace brazed design and contain epoxy lined shrink wrap on all aluminum to copper connections.
 2. Microchannel condenser coils shall be leak tested to 150 psig, pressure tested by supplier to 600 psig, and burst qualified to CSA C22.2 No. 60335-2-40.
 3. Assembled unit shall be pressure tested to 450 psig.

2.8 REFRIGERANT CIRCUITS

- A. 4 stage IntelliSpeed and Variable Air Volume airflow options shall have 2 independent refrigerant circuits with 4 stages of cooling.
- B. Refrigerant circuit shall include the following control, safety, and maintenance features:
 - 1. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range.
 - 2. Refrigerant filter drier - Solid core design.
 - 3. Service gauge connections on suction and discharge lines.
- C. Compressors
 - 1. Unit shall use fully hermetic scroll compressors for each independent refrigeration circuit.
 - 2. Four stage models shall use a two stage compressor on circuit one and a single stage compressor on circuit two.
 - 3. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
 - 4. Compressors shall be internally protected from high discharge temperature conditions.
 - 5. Compressors shall be protected from an over- temperature and over- amperage conditions by an internal, motor overload device.
 - 6. Compressor shall be factory mounted on rubber grommets.
 - 7. Crankcase heaters shall be installed in the factory as needed on tandem compressor sets.

2.9 EVAPORATOR FAN AND MOTOR

- A. Evaporator fan motor:
 - 1. Shall have permanently lubricated ball-bearings.
 - 2. Shall have inherent automatic- reset thermal overload protection.
 - 3. The job site selected brake horsepower shall be required to not exceed the motor's nameplate horsepower rating plus the service factor.
- B. Evaporator Fan:
 - 1. Fan shall be a belt drive assembly with an adjustable pitch motor pulley.
 - 2. Blower bearings shall have an L10 life of 100,000 hrs
 - 3. Shall use sealed, permanently lubricated ball-bearing type.
 - 4. Shall use dual blower design consisting of two balanced blower fans on a single shaft.
 - 5. Blower fan shall be double- inlet type with forward- curved blades.
 - 6. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

2.10 CONDENSER FANS AND MOTORS

- C. Condenser fan motors:
 - 1. Shall be a totally enclosed motor.
 - 2. Shall use permanently lubricated ball-bearings.
 - 3. Shall have inherent thermal overload protection with an automatic reset feature.
 - 4. Shall use a shaft- down design.
- D. Condenser Fans:
 - 1. Shall be a direct- driven propeller type fan.

2.11 SPECIAL FEATURES AND ACCESSORIES

- A. Variable Frequency Drive (VFD). Available on multi-speed (*IntelliSpeed*) and VAV indoor fan motor options:
 - 1. Shall be installed inside the unit cabinet, mounted, wired and tested.
 - 2. Shall contain Electromagnetic Interference (EMI) frequency protection.
 - 3. Insulated Gate Bi- Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform.
 - 4. Built in LED display and controls. Does not require additional kit or options.
 - 5. RS485 capability standard.
 - 6. Electronic thermal overload protection.
 - 7. All printed circuit boards shall be conformal coated.
- B. Low Leak Economizer:
 - 1. Integrated, tie-bar driven parallel modulating blade design type capable of simultaneous economizer and compressor operation.
 - 2. Damper blades shall be galvanized steel with tie-bar metal linkages. Plastic or composite blades on intake or return shall not be acceptable.
 - 3. Damper blades shall be class 1A dampers.
 - 4. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below set points.
 - 5. Shall be equipped with tie-bar driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
 - 6. Economizer shall comply with, and be certified to, the AMCA 511 standard.
 - 7. Standard leak rate shall be equipped with dampers not to exceed 3 cfm/ft² leakage at 1 in. wg pressure differential.
 - 8. Economizer controller shall be the Johnson Controls SE Economizer Controller
 - a) On- board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is not operating properly, meets the requirements for California Title 24, IECC 2015, and ASHRAE 90.1.
 - b) Display alarms if the following occur
 - i. Economizer is economizing when conditions do not support
 - ii. Economizer is not economizing when conditions do support
 - iii. Damper Stuck
 - iv. Excess Outdoor Air
 - v. Failed Sensor
 - c) Automatic sensor detection
 - d) Capabilities for use with multiple- speed indoor fan systems
 - e) Utilize digital sensors: Dry bulb and Enthalpy
 - f) UL, CSA, and ICES-003 recognized and FCC compliant to CFR47
 - 9. Shall be capable of introducing up to 100% outdoor air.
 - 10. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1 requirements. Barometric relief can be replaced by optional power exhaust.
 - 11. Shall be designed to close damper(s) during loss- of- power situations with spring return built into motor.
 - 12. Dry bulb outdoor air temperature sensor shall be provided as standard. Single or dual enthalpy sensing is available as a factory or field installed sensing option. Outdoor air

sensor set point shall be adjustable and shall range from 40° to 80°F / 4° to 27°C. Additional sensor options shall be available as accessories.

13. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
14. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
15. Dampers shall be completely closed when the unit is in the unoccupied mode.
16. Economizer controller shall accept a 2- 10 Vdc CO₂ sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
17. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.

C. MagnaDry Dehumidification System:

1. The MagnaDry Dehumidification system is factory installed and provides dehumidification of an occupied space while maintaining temperature control utilizing a hot gas reheat coil.
 - a) Determination of unit functionality in straight cooling, straight heating, or reheat mode shall come from standard SSE control board.
 - b) Reheat mode shall utilize a specific reheat coil placed after the evaporator coil to heat the conditioned air back to a neutral temperature when the occupied space requires dehumidification, but the temperature requirements are satisfied.
 - c) The reheat circuit shall utilize a 3-way electronic controlled valve to modulate the refrigerant between the condenser circuit and reheat circuit. .
 - d) Changeover from cooling mode to reheat mode shall be accomplished in 30 seconds or less.

D. Phase Monitor:

1. Shall provide protection against phase reversal, phase loss, and phase unbalance.
2. Switch shall automatically shut off unit control circuit if any of the above conditions is detected.
3. Shall have visual LED indication of operational status.

E. Hinged and toolless access panels:

1. Cabinet panels shall be hinged
2. Shall provide easy access with toolless latching mechanism
3. Shall be on major panels of: filter, control box, fan motor, and gas or electric heat controls.

F. Flue Exhaust Kit:

1. Flue exhaust shall provide redirection of flue products above the top of the unit prevent mixing with fresh air intake and combustion air supply.
2. Flue exhaust kit shall direct unit exhaust vertically instead of horizontally.

G. Louvered Hail/Coil Guard:

1. Shall cover all external sides of unit condenser coil to prevent damage or tampering.
2. Field kit shall contain all materials necessary to field install a coil guard.
3. Shall provide protection for the coil and header on the entire exposed surfaces of the outdoor coil

H. Unit- Mounted, Non- Fused Disconnect Switch:

1. Switch shall be factory installed, internally mounted.
2. National Electric Code (NEC) and UL approved non- fused switch shall provide unit power shutoff.
3. Shall be accessible from outside the unit.
4. Shall provide local shutdown and lockout capability.

I. Custom Roof Curbs

1. Custom roof curbs shall be as manufactured by Curb Technologies specifically for Johnson Controls Choice Series RTU's and be as detailed on the drawings.
2. Custom roof curb shall allow RTU vertical supply air and return air ducts to transition to horizontal configuration through curb wall.
3. Roof curbs shall be constructed of welded 12 gauge G90 galvanized steel construction and have factory-installed pressure treated 1"x4" wood nailers. All welds shall be coated with gold galvanizing paint.
4. 1 ½" x ¼" thick closed cell neoprene gasket shall be furnished for field installation.
5. Interior of roof curbs and duct collars shall be insulated with one 1" thick layer and one 2" thick layer of 1 ½ lb. coated fiberglass board for a total thickness of 3".
6. Horizontal supply air and return air ducts shall be provided through the roof curb wall and have 3" duct collars with nominal 2"x2" pressure treated wood nailers on outer perimeter of duct collars.
7. Turning valves shall be provided to minimize turbulence in the roof curb for the supply air and return air pathways.
8. Acoustical Duct lining
 - a) Manufacturers
 - i. Johns Manville.
 - ii. Owens Corning.
 - iii. Knauf.
 - a) Model numbers are based on Johns Manville to establish type and quality unless otherwise noted.
 - b) Protect the insulation from dirt, water, chemical attack and mechanical damage before, during and after installation. Any water damaged insulation shall be removed and replaced by the Contractor at no additional cost.
 - c) Installed curb and duct work shall have exposed insulation and openings capped to prevent entry of dirt or water.
 - d) Liners shall be Linacoustic RC Sealing treatments shall be by the liner manufacturer.
 - e) Liner shall have a minimum R, hr-ft²-F/BTU (Rsi, m²-C/W) as follows:

Thickness Inches	Angular Duct R (Rsi)	Plenum R (Rsi)
1	4.2 (0.74)	4.3 (0.76)
1½	6.3 (1.11)	6.3 (1.11)
2	8.0 (1.41)	8.7 (1.53)

- f) Liner shall have a minimum Noise Reduction coefficient when tested in accordance with ASTM C423 using a Type "A" mounting as follows:

Thickness. Inches	Angular Duct NRC	Plenum
1	0.70	0.75

1½	0.85	0.90
2	0.90	1.00

- g) The air stream surface shall have 100% coverage of an acrylic polymer coating formulated with an immobilized EPA registered preservative proven resistant to microbial growth as determined by ASTM G-21 and G-22.
- h) Liner shall have a flame spread no greater than 25 and a smoke developed no greater than 50 when tested as a composite in accordance with ASTM E84, UL 723 or NFPA 255.
- i) Liner shall be classified as meeting the requirements of limited combustibility per NFPA 90A.
- j) Liner shall conform to the requirements for emissions of total volatile organic compounds (TVOC) and formaldehyde (CHOH) in accordance with ASTM D5116-90.
- k) All portions of curb and ductwork designated to receive liner shall be completely covered. All sections shall be tightly butted together so that there are no interruptions or gaps.
- l) Liner shall be installed in accordance with manufacturer's installation instructions, MAIMA AH124 Fibrous Glass Duct Liner Standard and SMACNA HVAC Duct Construction Standards Metal and Flexible.
- m) The black, acrylic coated side of the liner shall face the air stream. Liner shall be cut to assure tight overlapped corner joints. Top pieces shall be supported by edge pieces.
- n) All transverse liner edges created by shop or field cuts shall be liberally coated with duct liner adhesive meeting ASTM C 916. Adhere liner to metal with minimum 90% coverage of adhesive meeting ASTM C 916.
- o) Secure duct liner with mechanical fasteners that comply with the requirements in SMACNA HVAC Duct Construction Standards Metal and Flexible.
- p) Maximum fastener spacing, inches (mm):

	0-2500 FPM Velocity	2501-5000 FPM Velocity
Transverse from wall	4 (102)	4 (102)
Between fasteners	2 (305)	6 (152)
Longitudinal from liner edge	3 (76)	3 (76)
Between fasteners	18 (457)	16 (406)

- q) Install metal nosing on all leading edges of liner wherever liner is preceded by unlined duct, at forward discharge, and when velocity exceeds 4000 fpm.
- r) Sealant shall be used to fill minor voids, gaps and indentations a 1/2 inch, and to repair minor surface damage that extends to no more than 10 percent of the liner thickness. Large voids and gaps 7-1/2 inches shall be repaired by cutting a small patch and coated with sealant.
- s) Upon completion of installation of the liner and before HVAC system startup, visually inspect the ductwork and verify that the duct liner has been correctly installed according to manufacturer's recommendations. Confirm that any damage to the air

stream surface has been properly repaired and that the duct is free from obstructions or debris.

- J. Non-Powered convenience outlet.
 - 1. Outlet shall be powered from a separate 115/120v power source.
 - 2. A transformer shall not be included.
 - 3. Outlet shall be factory installed and internally mounted with easily accessible 115- v female receptacle.
 - 4. Outlet shall include 15 amp GFI receptacles with independent fuse protection.
 - 5. Outlet shall be accessible from outside the unit.
- K. Modulating Power Exhaust:
 - 1. Power exhaust shall be used in conjunction with an integrated economizer.
 - 2. Exhaust fans shall be of centrifugal blower design with dual exhaust fans.
 - 3. Factory installed exhaust and field installed fold out exhaust shall achieve modulation of airflow from the use of ECM fan motors in conjunction with monitoring the static pressure differential between the building duct and outdoor ambient pressure.
 - 4. Bolt on field installed exhaust shall achieve modulation of airflow from the use of a Variable Frequency Drive in conjunction with monitoring the static pressure differential between the building duct and outdoor ambient pressure.
 - 5. Shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0- 100% adjustable set point on the economizer control.
 - 6. Factory installed exhaust shall have built in fold out rain hood design to reduce installation time.
 - 7. Field installed exhaust shall be either of same design as factory installed exhaust described above or of bolt on design, per customer selection.
- L. Dual Enthalpy Sensor:
 - 1. The dual enthalpy sensor option or kit shall provide 2 relative humidity sensors to be mounted in the return and outdoor air streams to provide dual enthalpy economizer control.
 - 2. This kit contains all components required for dual enthalpy control and does not need to be used in conjunction with the Single Enthalpy Sensor Kit.
- M. CO₂ Sensor:
 - 1. Shall be able to provide demand ventilation control for indoor air quality (IAQ).
 - 2. The CO₂ sensor shall be available in duct mount or wall mount with LED display.
 - 3. The set-points for IAQ and OAQ shall have adjustment capability between 0 and 5000 ppm in the Simplicity Smart Equipment controls.
- N. Low Ambient Kit:
 - 1. Shall contain an integrated low ambient controller to regulate condenser head pressure at low ambient temperatures by varying the amount of airflow through the condenser.
 - 2. 15 and 17.5 ton models shall have a single controller while 20, 25, and 27.5 ton models shall have 2 controllers.
 - 3. Shall allow units to operate in cooling mode down to 0° F outdoor ambient.
 - 4. Shall be required when full mechanical cooling is required at temperatures below 40° F.
- O. High SCCR:

1. Shall achieve short-circuit current rating of 65 kA on 208/230V and 460V units, and 25 kA on 575V units, an increase from the standard 5 kA rating.
 2. All necessary electrical components and wiring are sized to achieve the high SCCR rating.
 3. Provides additional protection to unit and equipment in the event of a short-circuit condition.
- P. Condensate Overflow Switch:
1. Shall utilize float switch in condensate drain pan to signal if water level rises above acceptable threshold.
 2. Switch shall detect a 0.25 inch rise above mounted location to determine need to send shutoff signal.
 3. Shall send 24V signal to unit controller when tripped to shut down cooling operation and prevent additional buildup of water in condensate drain pan

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify roof curbs are installed and dimensions are as shown on shop drawings and instructed by manufacturer.

3.2 PREPARATION

- A. Furnish roof curbs to general contractor for installation.

3.3 INSTALLATION

A. Installation, Operation and Maintenance – Packaged Rooftop Units, RTUs

- 1. Installation, Operation, and Maintenance manual shall be supplied with the unit.
- 2. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
- 3. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

B. Roof Curb:

- a. Assemble roof curb.
- b. Install roof curb level.
- c. Coordinate curb installation and flashing with general contractor.
- d. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
- e. Install gasket material between unit base and roof curb.

C. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.

D. Install condensate piping with trap and route from drain pan to splash block on roof.

E. Install components furnished loose for field mounting.

F. Install electrical devices furnished loose for field mounting.

G. Install control wiring between unit and field installed accessories.

H. Remove from roof and dispose off-site panels removed from units during installation of economizer and dampers.

I. Locate remote panels as indicated on Drawings.

J. Provide fixed sheaves required for final air balance.

3.4 INSTALLATION - NATURAL GAS HEATING SECTION

A. Connect natural gas piping in accordance with NFPA 54.

B. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.

C. Install the following piping accessories on natural gas piping connections. Refer to Section 22 11 23.

- a. Strainer.
- b. Pressure gage.
- c. Shutoff valve.
- d. Pressure reducing valve.

D. Install natural gas piping accessories above roof and/or within unit casing.

3.5 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

B. Furnish services of factory trained representative for minimum of five days to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Vacuum clean coils and inside of cabinets.

C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.7 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate unit operation and maintenance.

C. Furnish services of manufacturer's technical representative two 4 hour sections to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days' notice to Owner and/or Design Professional of training date.

END OF SECTION 23 73 00

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SECTION 23 81 23 – COMPUTER ROOM AIR CONDITIONERS

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SECTION 23 81 23 – COMPUTER ROOM AIR CONDITIONERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. These specifications describe requirements for a ceiling mounted thermal management system. The system shall be designed to control temperature conditions in rooms containing electronic equipment, with good insulation and vapor barrier. The system is also available with an optional humidity control package.

The manufacturer shall design and furnish all equipment in the quantities and configurations shown on the project drawings.
- B. Design Requirements:
 - 1. The thermal management system shall be a Liebert® Mini-Mate Variable Capacity factory assembled unit. On direct expansion models, the refrigeration system shall be split, with the compressor located in a remote condensing unit.
 - 2. The evaporator section shall be designed for above dropped ceiling installation. Condensing units shall be designed for outdoor installation. Refer to Section 2.8.2 for condensing unit guide specifications.
 - 3. System shall be supplied with CSA Certification to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for “Heating and Cooling Equipment” and marked with the CSA c-us logo (60 Hz only).
- C. Related Sections:
 - 1. Section 25 05 03 – Pipes and Tubes for HVAC Piping and Equipment
 - 2. Section 23 21 13 - Hydronic Piping: Execution requirements for water, glycol, refrigerant and drain piping specified by this section.
 - 3. Section 23 40 00 - HVAC Air Cleaning Devices: Product requirements for filters for placement by this section.
 - 4. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.3 REFERENCES

- A. Air-Conditioning, Heating, and Refrigeration Institute
 - 1. ARI 210/240 - Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
 - 2. ARI 340/360 - Performance Rating of Commercial and Industrial Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- C. American Society of Mechanical Engineers:
 - 1. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
- D. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers' literature and data indicating water, drain, refrigeration, and electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit procedures for rigging and making service connections.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Indicate conditions at initial start-up including date, and initial set points.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

- A. The specified system shall be factory-tested before shipment. Testing shall include, but shall not be limited to: Quality Control Checks, "HiPot" Test (two times rated voltage plus 1000 volts, per NRTL agency requirements) and Metering Calibration Tests. The system shall be designed and manufactured according to world class quality standards. The manufacturer shall be ISO 9001 certified.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three five years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Comply as applicable with Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply as applicable with Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept computer room units on site in factory packing. Inspect for damage.
- C. Protect units from damage by storing away from computer room until floor and ceiling are installed.

1.10 WARRANTY

- A. Comply as applicable with Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of filters for each unit.

PART 2 PRODUCTS

2.1 STANDARD FEATURES/ALL SYSTEMS

- A. Evaporator Cabinet Construction
 - 1. The cabinet and chassis shall be constructed of heavy gauge galvanized steel and shall be serviceable from one side only for routine maintenance. Mounting brackets shall be integral to the cabinet design. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity and Erosion, tested per UL 181 and ASTM 1338 standards.
- B. Remote Sensors
 - 1. The unit shall be supplied with remote temperature and humidity sensors. The sensors shall be factory provided in an aesthetically pleasing housing with a 30 ft. (9 m), shielded cable and shall be field mounted and field wired to the unit electrical panel.

- C. Air Distribution
 - 1. The fan shall be plug/plenum type, with motorized impeller, single inlet and dynamically balanced. The drive package shall be direct drive, electronically commutated (EC) and variable speed. The fan speed shall be automatically regulated by the Vertiv™ Liebert® iCOM™ control through all modes of operation. The fans shall be located to draw air over the coil to ensure even air distribution and maximum coil performance.
 - 2. System shall be suitable for bottom supply grille and ducted return air distribution. Supply air location shall be field selectable, configured in one of three outlet locations: back of cabinet, right side, or bottom of cabinet. The bottom supply configuration requires an additional kit (ordered and shipped separately). Refer to 2.8.A Air Filter Box/Duct Flange, and 2.8..B Bottom Discharge Grille.
- D. Unit Controls, Protections and Communication Terminals
 - 1. The Vertiv™ Liebert® Mini-Mate shall include Vertiv™ Liebert® iCOM™ control with remote 9-in. color touchscreen display, a filter clog switch, common alarm contact, and remote shutdown contacts. Filter clog switch shall be adjustable outside the cabinet and shall activate an iCOM alarm when the pressure drop across the filters exceeds the customer adjustable level. Common Alarm Contact shall be one set of normally open contacts which shall close for remote indication of alarms. Remote Shutdown Contact shall enable unit shutdown based on external input.

2.2 LIEBERT ICOM MICROPROCESSOR CONTROL WITH REMOTE

- A. The Liebert® iCOM™ shall be microprocessor based with a remote 9-in. color touchscreen display and shall be mounted in an ergonomic, aesthetically pleasing housing. The controls shall be menu driven. The system shall display user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in percentage of each function, date and time), total run hours, various sensors, display setup, and service contacts. A password shall be required to make system changes. Service menus shall include setpoints, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, maintenance/wellness settings, options setup, system/network setup, auxiliary boards, and diagnostics/service mode.
 - 1. Password Protection - The Liebert® iCOM™ shall contain two unique passwords to protect against unauthorized changes. An auto hide/show feature allows the user to see applicable information based on the login used.
 - 2. Unit Backup and Restore - The user shall be able to create safe copies of important control parameters. The Liebert® iCOM™ shall have the capacity for the user to automatically back up unit configuration settings to internal memory or USB storage drive. Configuration settings may be transferred to another unit for a more streamlined unit startup.
 - 3. Parameter Download - The Liebert® iCOM™ shall enable the user to download a report that lists parameter names, factory default settings, and user programmed settings in .csv format for remote reference.
 - 4. Parameter Search - The Liebert® iCOM™ shall have search fields for efficient navigation and parameter lookup.
 - 5. Setup Wizards - The Liebert® iCOM™ shall contain step-by-step tutorials or wizards to provide easy setup of the control. This shall be for 4 ton and 5-ton models only.
 - 6. Context Sensitive Help - The Liebert® iCOM™ shall have an onboard help database. The database shall provide context sensitive help to assist with setup and navigation of the menus.
 - 7. Display Setup - The user shall have the ability to configure the Liebert® iCOM™ information based on the specific user's preference. Language, units of measure, screen contrast, home screen layout, backlight timer and the hide/show of certain readouts shall be configurable through the display.

8. Additional Readouts - The Liebert® iCOM™ shall permit the user to configure custom widgets on the main screen. Widget options shall include items such as fan speed, call for cooling, call for free-cooling, maintenance status, call for electric reheat, call for dehumidification, call for humidification, airflow, static pressure, fluid flow rate, and cooling capacity.
9. Status LED's - The Liebert® iCOM™ shall provide the user with the unit's operating status using an integrated LED. The LED shall indicate if the unit has an active alarm; if the unit has an active alarm that has been acknowledged; or if the unit is On, Off or in standby status.
10. Event Log - The Liebert® iCOM™ shall automatically store the last 400 unit only events (messages, warnings, and alarms).
11. Service Contact Information - The Vertiv™ Liebert® iCOM™ shall have the ability to store the local service or sales contact information.
12. Upgradeable - Liebert® iCOM™ upgrades shall be performed through a USB connection.
13. Timers/Sleep Mode – The menu shall allow various customer settings for turning on/off unit.
14. Menu Layout - The menus shall be divided into two main menu screens: User and Service. The User screen shall contain the menus to access parameters required for basic unit control and setup. The Service screen shall be designed for service personnel and provides access to advanced control setup features and diagnostic information.
15. Sensor Calibration – The menus shall allow unit sensors to be calibrated with external sensors.
16. Maintenance/Wellness Settings - The menus shall allow reporting of potential component problems before they occur.
17. Options Setup - The menus shall provide operation settings for the installed components.
18. Various Sensors - The menus shall allow setup and display of optional custom sensors. The control shall include four customer accessible analog inputs for field provided sensors. The analog inputs shall accept a 4 to 20mA signal. The user shall be able to change the input to 0 to 5 VDC or 0 to 10 VDC. The gains for each analog input shall be programmable from the front display. The analog inputs shall be able to be monitored from the front display.
19. Diagnostics/Service Mode - The Liebert® iCOM™ shall be provided with self-diagnostics to aid in troubleshooting. Control inputs shall be indicated as On or Off at the front display. Control outputs shall be able to be turned On or Off from the front display without using jumpers or a service terminal. Each control output shall be indicated by an LED on a circuit board.

2.3 ALARMS

- A. All unit alarms shall be annunciated through both audio and visual cues, clearly displayed on the screen, automatically recorded in the event log and communicated (4 and 5 ton require optional communication card) to the customer's building management system/building automation system. The Liebert® iCOM™ shall activate an audible and visual alarm in the event of any of the following conditions:
 1. High Temperature
 2. Low Temperature
 3. High Humidity
 4. Low Humidity
 5. EC Fan Fault
 6. Change Filters
 7. Loss of Air Flow
 8. Loss of Power
 9. Humidifier Problem
 10. High Water (drain pan)
 11. High Head Pressure
 12. High Discharge Temperature (Compressor)
 13. Low Suction Pressure
 14. Custom Alarms

- B. Custom alarm inputs shall be provided to indicate facility specific events. Custom alarms can be identified with programmable labels. Frequently used alarm inputs shall include:
 - 1. Smoke Detected (requires optional smoke sensor)
 - Standby Unit On
- C. Each alarm (unit and custom) shall be separately enabled or disabled, selected to activate the common alarm and programmed for a delay of 0 to 255 seconds.

2.4 LIEBERT ICOM CONTROL METHODS AND OPTIONS

- A. The Liebert® iCOM™ shall be flexible in the sense that it shall allow controlling the capacity and fan from multiple different sensor selections. The sensor selections shall be:
 - 1. Cooling Capacity
 - a. Remote
 - b. Return
 - 2. Fan Speed
 - a. Remote
 - b. Return
 - c. Manual (for diagnostics or to receive a signal from the BMS through Liebert remote monitoring devices or analog input)
- B. Temperature Compensation
 - 1. The Liebert® iCOM™ shall have the ability to adjust the capacity output based on return temperature conditions to meet SLA guidelines while operating to highest efficiency.
- C. Humidity Control
 - 1. Dew point and relative humidity control methods shall be available (based on user preference) for humidity control within the space.

2.5 REMOTE MONITORING

- A. All alarms shall be communicated to the Liebert site monitoring system with the following information: date and time of occurrence, unit number and present temperature and humidity. Communication card is required.

2.6 DIRECT EXPANSION SYSTEM COMPONENTS

- A. Indoor Evaporator Unit
 - 1. The evaporator section shall include evaporator coil, thermostatic expansion valve and filter drier. The evaporator coil shall have 5.6 sq. ft. (0.52 sq. m) face area, four rows deep. It shall be constructed of internally rifled copper tubes and lanced type aluminum fins. An externally equalized thermostatic expansion valve shall control refrigerant flow. The evaporator coil shall be factory charged with nitrogen and sealed. The system shall be field charged with field supplied R-410A refrigerant.
 - 2. The coil assembly shall be mounted in a condensate drain pan with internally trapped drain line. The evaporator drain pan shall include a factory installed float switch to shut down the evaporator upon high water condition.
- B. Outdoor Air Cooled Prop Fan Condensing Unit

1. The condensing unit shall be designed for outdoor use with either roof or ground level mounting. The condensing unit is constructed of galvanized and galvalume painted steel for corrosion resistance. Removable exterior panels shall allow access to the electric panel or refrigeration components for service or maintenance. Both inlet and outlet air grilles shall be heavy duty steel with a durable polyester coating.
 2. Condensing unit components shall include a condenser coil, a direct drive propeller type fan, a variable capacity digital scroll compressor, high pressure switch, high compressor discharge temperature switch, Vertiv™ Liebert® Lee-Temp insulated receiver with internal heater and head pressure control valve, and liquid line solenoid valve. The condensing coil shall be constructed of copper tubes and aluminum fins.
 3. High head pressure switch shall protect the unit from abnormal refrigerant pressure conditions. Switch and sensor inputs shall be integrated with Liebert® iCOM™ for compressor protection while maintaining system and evaporator blower operation, displaying alarms at the wall display and providing system shutdown when required.
 4. A pressure balancing valve shall be factory installed to reduce the chance of opening the high pressure relief valve due to excessive refrigerant migration to the receiver due to changing outdoor temperatures during off cycles.
 5. All components shall be factory-assembled, charged with nitrogen and sealed. System shall be field charged with field supplied R-410A refrigerant. No internal piping, brazing, or dehydration shall be required. Condensing unit shall be designed for 95°F (35°C) ambient and shall be capable of starting and continuous operation down to -30°F (-34.4°C).
 6. The condensing unit shall be designed to operate at a sound level less than 58 dBA.
 7. The condensing unit shall be designed to provide stated system capacity at 105°F (40.5°C) ambient.
- C. Digital Scroll High Temperature Protection
1. The control shall monitor digital scroll temperature during unit operation. A compressor temperature limit shall be imposed to help prevent damage to the compressor. If the temperature reaches the maximum temperature limit, the compressor shall be locked out and an alarm shall be annunciated on the local display and through remote monitoring. After the initial lockout, the control shall continue to monitor compressor temperature during the off cycle and shall re-enable the circuit once a safe operating temperature is reached (minimum 30-minute lockout). After five high discharge temperature alarms within a rolling 4-hour period, the control shall lock out the compressor until power is cycled to the evaporator unit.
- D. Digital Scroll Sensor Failure
1. The control shall monitor the status of the digital scroll sensor(s). If the control senses the thermistor becomes disconnected, shorted or the reading goes out of range, the user will be notified through an event on the local display and remote monitoring.

2.7 FACTORY-INSTALLED OPTIONS

- A. Steam Generating Humidifier
1. The Thermal Management system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, 1-in. (25.4mm) air gap on fill line, inlet strainer, steam distributor and electronic controls. The need to change canister shall be annunciated on the wall mounted controller. The humidifier shall have a capacity as scheduled. An LED light on the humidifier assembly shall indicate cylinder full, overcurrent detection, fill system fault and end of cylinder life conditions. The canister flush water shall not drain into the coil drain pan due to risk of aggressive corrosion of the evaporator coil. The humidifier wand shall be mounted over the coil drain pan.

- B. Electric Reheat
1. The electric reheat shall be low watt density, 304/304 stainless steel, finned tubular and shall be capable of controlling room dry bulb temperature conditions when the system is calling for dehumidification or heating. The reheat section shall include a UL/CSA recognized safety switch to protect the system from overheating. The capacity of the reheat coils shall as scheduled. A ground current detector shall be factory installed to shut down the entire unit if a ground fault in the reheat system is detected.
- C. SCR Electric Reheat
1. SCR Electric Reheat option shall be an electric reheat element controlled by a variable output Silicon Controlled Rectifier (SCR) control. The SCR reheat shall provide precise temperature control while minimizing energy input utilizing iCOM control and digital scroll. Reheat capacity shall be 15 kW to offset the cooling capacity.
- D. Disconnect Switch, Locking (65,000 amps SCCR)
1. The non-automatic, locking, molded case circuit breaker shall be factory mounted in the high voltage section of the electrical panel. The switch handle shall be accessible from the front of the indoor unit and shall have a lockable handle to support lockout/tagout safety programs. The short circuit current rating for the evaporator unit shall be 65,000 amps.
- E. High Temperature Sensor
1. The high temperature sensor shall immediately shut down the system when high temperatures are detected. The high temperature sensor shall be mounted with the sensing element in the return air.
- F. Smoke Sensor
1. The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The sensing element shall sense the return air conditions. This smoke sensor shall not function or replace any room smoke detector that may be required by local or national codes.
- G. IS-Unity-DP-CMS-Card
1. The IS-UNITY-DP-CMS card shall provide mobile cloud access, remote access to the unit level display via the world wide web and building management system (BMS) access via LON Works. Card shall be factory installed in the IntelliSlot card housing on outside of cabinet.
- H. Low Voltage Terminal Package
1. The Low Voltage Terminal Package shall include:
 - a. Two additional remote input shutdown terminals
 - b. Two extra common alarm N/O output contacts
 - c. One main fan auxiliary N/O output contact
 - d. One remote humidifier N/O output contact
 - e. One Vertiv™ Liebert® Liqui-Tect™ input terminals

2.8 SHIP-LOOSE ACCESSORIES

- A. Air Filter Box/Duct Flange
 - 1. The evaporator section shall be supplied with an optional air filter box kit for use with ducted installations. Two filters shall be included 4 in. x 20 in. x 20 in. (102 mm x 508 mm x 508 mm) each, pleated type, with a MERV 8 rating, based on ASHRAE 52.2-2007. A duct flange shall be supplied for use on the supply air opening of the unit.
- B. Bottom Discharge Grille
 - 1. A 3-way louvered discharge air grille, painted white, shall be added to an independent T-bar ceiling grid assembly for air discharge directly into room from bottom of unit. Kit shall include air baffle and rear discharge block off plate.
- C. Condensate Pump
 - 1. The condensate pump shall have the capacity of 5.1 GPM at 10 ft. head.. It shall be complete with integral float switch, pump, motor assembly, discharge check valve, duct/wall mountable bracket and reservoir. A secondary float switch shall be provided to permit field wiring to the unit control to shut down the evaporator upon a high water level condition.
- D. Condensate Pump Bracket
 - 1. A condensate pump bracket shall be provided to mount condensate pump directly to the end of the unit, allowing for easier installation and alignment of the condensate pump.
- E. Liebert Liqui-tect 410 Point Leak Detection Sensor
 - 1. A total of one (quantity) solid state water sensor(s) with no moving parts and hermetically sealed to keep out dust and dirt shall be provided. The Liebert® Liqui-Tect™ 410 (LT410) shall provide a single point detection of leaks. The point detection sensor shall have two gold plated sensing probes to prevent corrosion resistance and to provide accurate readings. The LT410 shall constantly monitor points for leaks, internal faults, and power failures and warn of any abnormal conditions. Mounting brackets shall allow for sensor height adjustment and leveling. The LT410 shall provide two independent outputs to signal both a local alarm panel and a remote building management system or external equipment. The LT410 shall be rated for 24 VAC, 50/60 Hz and 0.10 amps. Liebert® Liqui-Tect™ sensor shall be field mounted and field wired to both monitoring contacts and 24 VAC supply power.

PART 3 EXECUTION

3.1 INSTALLATION OF AIR CONDITIONING UNIT

- A. General
 - 1. Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored in location indicated, and maintain manufacturer's recommended clearances.
- B. Electrical Wiring
 - 1. Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor. Install and wire per local and national codes.
- C. Piping Connections
 - 1. Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.
- D. Supply and Drain Water Piping

1. Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.
- E. Field-Supplied Pan
 1. A field-supplied pan with drain with moisture sensor shall be installed beneath ducted cooling units. Refer to Section 23 05 00 – 2.1 for Construction.

3.2 FIELD QUALITY CONTROL

- A. Startup air conditioning unit in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements.

END OF SECTION 23 81 23

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SECTION 23 84 13 – ELECTRIC-TO-STEAM HUMIDIFICATION SYSTEM

PART 1 — GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

Section includes:

- 1. DRI-STEEM Corporation, RTS electric steam humidifier
- 2. Rapid-sorb Dispersion Tube System

Related items:

- 3. Electrical Service and Connections: Division 26

1.3 REFERENCES

Certifications:

- 1. ETL, C-ETL
- 2. CE
- 3. Seismic Rated

1.4 SUBMITTALS

Comply with Submittal Procedures and Execution and Closeout Requirements in General Requirements.

Submit product data (manufacturer's specifications, and technical data including performance, construction and fabrication) for each manufactured component.

1.5 WARRANTY

Product shall be warranted to be free from defects in materials and fabrication for a period of two years after installation or 27 months from ship date.

PART 2 — PRODUCTS

- 2.1 Humidifier shall be RTS Electric Resistive Evaporative Steam Humidification System or engineer-approved equal.

Fabrication requirements:

- 1. Tank and heater plate
 - a. Tank and heater plate: 14-gauge 316-stainless steel with Heli-arc welded seams
 - b. Tank bottom shall be dual sloped with side exit drain port located at bottom of slopes to ensure complete draining of tank.
 - c. Steam outlet on top of tank configured to connect to hose and pipe (NPT or BSP connection) for all sizes, and including flanged pipe connection option on -3 and -4 stage units.

- d. Quick removable heater plate with weld studs, flange nuts and gasketed flanges shall be located at the front of the tank. There shall be no in board flange on tank to allow for easy tank cleaning.
2. Units shall be capable of fitting through a 36" (91 mm) wide door.

Immersion heater(s): Heater(s) shall be Incoloy alloy-sheathed resistance type designed for no more than 91 watts per square inch. Two threaded ends of each heater element shall pass through the heater plate at the front of the evaporating chamber and be secured and sealed with Thermoseal synthetic gaskets, safety washers, and threaded nuts.

Water type, fill, and drain requirements:

1. The humidifier shall be capable of generating steam from well, tap, softened, DI or RO water.
2. The humidifier shall not require changes to controls or components in the field due to changes in water type.
3. The humidifier shall sense water purity and automatically adjust drain rates accordingly to minimize tank maintenance and optimize water usage.
4. Fill line plumbing shall include anti-siphoning mechanisms that prevent tank siphoning and potential inlet water contamination.
5. Humidifier shall incorporate a water surface skimming feature to drain away water surface debris and contaminants to minimize tank cleaning maintenance and risk of foaming.
6. An electric full port ball valve shall be mounted on humidifier assembly to allow tank to drain automatically at the end of a humidification season.
 - a. Provide complete tank draining with no standing water.
 - b. Minimum 5 gpm flow rate for fast draining.
 - c. The system shall monitor drain water temperature with temperature viewable on the unit's display.
7. Integral water tempering control shall meter cold water at the drain in order to temper 212°F (100°C) water to a maximum 140°F (60°C) discharge temperature at full drain rate to sanitary system during normal operation.
 - 1) Drain water tempering shall employ closed loop feedback using the drain temperature sensor to automatically control the drain and fill valves. Drain water temperature shall not exceed 140 °F (60 °C) while system shall minimize (cold) water usage by not excessively tempering.
 - 2) Minimize drain and refill time by sensing when water is no longer draining (tank empty) to quickly initialize refilling of tank and subsequent re-start of humidification.

2.2 HUMIDIFIER OPTIONS

A.Mounting options:

1. Outdoor enclosure system:
 1. Factory assembled and tested with the humidifier installed to provide complete weather protection and to operate within the following limits:
 - a. Temperature: -40 to 122 °F (-40 to 50 °C)
 - b. Sustaining winds: up to 40 mph
 2. Humidifier and outdoor enclosure shall be shipped as one unit.
 3. Base construction is 14-gauge, formed G-90 galvanized steel, suitably reinforced and braced to permit loading, shipping, unloading and rigging to the unit destination without damage to external or internal components. The base frame shall be corrosion resistant without painting or further coating.

4. Housing construction: 18-gauge, G-90 galvanized steel panels fabricated into self-framing, double standing seam-type construction. All vertical panel joints, including the access panels, shall have weather stripping applied to them. All vertical stationary panels shall be caulked at the base with a weather-tight silicone sealant. All interior surfaces shall be insulated. There shall be a drain connection on the exterior of the enclosure.
5. Access panel construction: Access panels shall provide access to all internal components, be constructed of 18-gauge, G-90 galvanized steel weather stripping on the vertical panel joints.
6. Ventilation fans: Ventilation fans shall draw ambient air into enclosure and be thermostatically controlled to operate only when cabinet interior exceeds temperature setpoint.
7. Heater:
 - a. The enclosure shall have a thermostatically-controlled heater to ensure proper operation during cold weather.
8. Roof curb: The roof curb shall be manufactured of 14-gauge, galvanized steel and provided with necessary hardware for bolt-together assembly. The curb is to be a minimum of 14" (356 mm) high.
 - a.
9. Internal steam plumbing option: The outdoor enclosure shall have piping to discharge steam through the base of the unit.

B. Seismic Certification:

1. Outdoor models – Base mount or 14" tall curb only
- b.

2.3 HUMIDIFIER CONTROLS

A. Control subpanel: Control subpanel shall be factory-attached to humidifier with all wiring between subpanel and humidifier completed at factory. A wiring diagram shall be included.

B. Vapor-logic microprocessor controller with the following features or functions:

1. Touchscreen user interface shall be included standard on all models
 1. Minimum 5" (125 mm) diagonal 800 x 480 24 bit RGB color display
 2. Touch-sensitive screen control including swipe-scrolling of lists
 3. Display operable within a temperature range of 32 to 158 °F (0 to 70 °C)
 4. Animated graphical display of humidifier operating conditions
 5. Icon-based function keys on screen with consistent Home option to facilitate navigation
 6. Setup wizard, context-sensitive Help screens and output test functions for unit commissioning
 7. On-screen QR Code links to humidifier installation literature
 8. Prioritized color-coded alerts with time & date of occurrence, including log of up to 60 prior event messages.
 9. Unit name information; editable with full qwerty on-screen keyboard.
 10. Adjacent four-color LED status light of humidifier operating condition
2. Web interface and server, included standard on all models:
 1. Web interface shall have same functionality as Vapor-logic touchscreen display
 2. Web interface shall allow multiple remotely located users to simultaneously view system operation and/or change system parameters.
 3. Web interface shall have password-protected secure access.
 4. Web interface shall be compatible with standard Internet browsers.

5. Web interface shall connect directly to a personal computer or through a system network via Ethernet cable.
3. Touchscreen display shall be factory mounted on humidifier.
 1. Remote mount (5-500 feet): Touchscreen user interface shall be provided for installation at location noted on drawings. Humidifier to be supplied with power/communications cable to connect touchscreen.
4. Controller shall provide fully modulating control of humidifier capacity.
5. Controller shall provide PID control capability with field-adjustable settings.
6. Water level control:
 1. Automatic refill, low water cutoff, surface skimming and automatic drain-down of humidifier. System shall consist of:
 - a. A water level sensing unit comprised of three metallic probes mounted in probe head. Probe head shall incorporate probe isolation chamber to eliminate fouling caused by mineral coatings.
 - b. Fill valve assemblies factory mounted on the humidifier assembly.
 - c. End-of-season drain automatically drains humidifier tank after a user-defined period of system inactivity.
7. Temperature sensor: A factory mounted sensor, with a temperature range of -40 to 248 °F (-40 to 120 °C) shall be mounted on the humidifier to enable the following functions:
 - a. Maintain the evaporating chamber water temperature above freezing.
 - b. Maintain a user-defined preset evaporating chamber water temperature.
 - c. Allow rapid warm-up of water in evaporating chamber after a call for humidity, providing 100% operation until steam production occurs.
 - d. Provide backup over-temperature protection for the over-temperature fuse.
8. Over-temperature fuse: A factory-mounted and wired UL-listed limit control fuse, operating independently of the tank temperature sensor, shall sense an over-temperature condition and de-energize heater circuit controls.
9. USB port on the control board and touchscreen for software updates, data backups, and data restoration.
10. Up-time optimizer function to keep humidifier(s) operating through conditions such as fill, drain, or run-time faults, as long as safety conditions are met, minimizing production down-time.
11. Real-time clock to allow time-stamped alarm/message (alert) tracking, and scheduled events.
12. Alarms (alerts), unit configuration, and usage timer values shall remain in nonvolatile memory indefinitely during a power outage.
13. The capability to monitor, control, and/or adjust the following parameters:
 1. Relative humidity (RH) set point, actual conditions in the space (from humidity transmitter), RH offset
 2. Dew point set point, actual conditions in the space (from dew point transmitter), dew point offset
 3. Relative humidity (RH) duct high limit set point (switch) and actual conditions
 4. Relative humidity (RH) duct high limit set point, actual conditions (from transmitter), high limit span, and high limit offset
 5. Total system demand in % of humidifier capacity
 6. Total system output in lbs/hour (kg/h)
 7. Drain/flush duration, allowed days, and frequency based on usage.
 8. End-of-season drain status and hours humidifier is idle before end of season draining occurs
 9. Window glass surface temperature (in % RH offset application using sensor ordered as an option) with programmable offset
 10. Air temperature or other auxiliary temperature monitoring with programmable offset (using sensor ordered as an option)
 11. System alarms (alerts) and system messages, current and previous

12. Adjustable water skim duration
13. Programmable outputs for remote signaling of alarms and/or messages (alerts), device activation (such as a fan), or for signaling tank heating and/or steam production
14. System diagnostics that include:
 - a. Test outputs function to verify component operation
 - b. Test humidifier function, by simulating demand to validate performance
 - c. Data collection of RH, water use, energy use, alarms (alerts), and service messages for download to USB.
15. Password-protected system parameters
16. Touchscreen display or Web interface displays in English, French, Spanish, Dutch or German languages
17. Numerical units displayed in inch-pound or SI units

2.4 HUMIDIFIER CONTROL OPTIONS

A.Interoperability using LON Works MS/TP.

B.Removable touchscreen display option: Provide a touchscreen display with cable and quick-connect terminals for remote use. Available cable lengths: 5' (1.5 m), 10' (3 m), 25' (7.6 m), 50' (15 m), 100' (30 m) or 500' (152 m).

C.Control input accessory:

1. Humidity transmitter, duct: Humidity transmitter shall be a duct-mounted device that measures from 0% to 100% RH range and provides a linear output (10% to 90% RH) from 4 to 20 mA. Accuracy $\pm 2\%$ RH. Supply voltage 21 VDC. Operating temperature range: -4 to 140 °F (-20 to 60 °C).
2. Dew point transmitter: A dew point transmitter (duct- or room-mounted) shall measure the humidity and temperature in the environment and then compute the dew point. Output 4 to 20 mA (700 ohms maximum). Supply voltage 21 VDC. Operating temperature range when duct-mounted: -40 to 185 °F (-40 to 85 °C).
3. Auxiliary temperature sensor/transmitter: Auxiliary temperature sensor and transmitter shall allow air temperature monitoring, such as in a duct, and shall enable temperature compensation to prevent window condensation. Temperature transmitter, operating temperature range -20 to 160 °F (-29 to 71 °C), shall be provided for field installation. Transmitter shall supply its signal (4 to 20 mA) to the microprocessor control system, which shall lower the indoor RH set point to a level 5% or more below the dew point temperature during a cold spell, thus preventing window condensation. The indoor RH shall be automatically returned to the normal setting when the glass temperature rises.
4. Modulating high limit control: The modulating high limit control system shall include a modulating electronic humidity transmitter (duct-mounted downstream from the humidifier). It shall transmit to the microprocessor controller to modulate humidifier output and maintain the highest desired space humidity possible, at all airflow volumes, without saturation of the airstream. (For this application, it is recommended to use a sail type airflow-proving switch.)
5. Airflow proving switch, sail type: Airflow proving switch shall be a sail operated electric switch for field installation. Switch makes @ 250 fpm (1.3 m/s), breaks @ 75 fpm (0.4 m/s). Maximum operating temperature for sail: 170 °F (77 °C). Maximum operating temperature for switch: 125 °F (52 °C).

2.5 RAPID-SORB DISPERSION TUBE SYSTEM

Rapid-sorb dispersion tube system injects evaporative, non-pressurized steam into ducted air for humidification.

Rapid-sorb, shall be field-assembled and include the following components:

- c. Steam supply header
- d. Dispersion tube(s)
- e. Top support bracket
- f. Duct plate(s)

Each dispersion tube shall be fitted with two rows of steam discharge tubelets inserted into the tube wall, to meet specified absorption distances. The two rows of tubelets in each dispersion tube shall discharge steam in diametrically opposite directions, perpendicular to airflow.

Each tubelet shall extend through the wall of and into the center of the dispersion tube and contain a steam orifice sized for its required steam capacity.

The humidifier shall provide absorption characteristics and shall be as scheduled.

Air pressure loss across the humidifier panel shall be as scheduled.

Rapid-sorb assemblies are typically installed centered side to side in duct, or across face of coil in air handler. The center line of the outer dispersion tubes shall not be closer than 4.5" (114 mm) from side of ductwork or air handler wall.

Condensate drain connections to the Rapid-sorb header shall be minimum ¾" I.D. and rated for 212°F minimum continuous operating temperature.

Tubes shall be joined to headers with removable fittings to facilitate easy removal:

- g. Coupling fitting for 1 ½" dia. dispersion tubes
- h. Hose cuff and clamps for 2" dia. dispersion tubes

Tubes, header, and support bracket shall be 316 stainless steel and be Heli-arc welded.

Duct plate(s) shall be 304 stainless steel.

High-efficiency dispersion tubes:

- 3. Dispersion tubes shall be insulated with a plenum-approved insulating material for in-duct installation and have an R-value not less than 0.5.
- 4. Airstream heat gain shall not exceed values specified on the humidifier schedule; the values shall be supported by manufacturer's published data.
- 5. Insulating material shall meet the following criteria at 0.125" (3.2 mm) thickness:
 - a. Fire/smoke index shall be 0/0 per any of the following test procedures:
 - UL 723 fire/smoke index (Test for Surface Burning Characteristics of Building Materials)
 - NFPA 255 (Standard Method of Test of Surface Burning Characteristics of Building Materials)
 - ASTM E84 (Surface Burning Characteristics for Materials Used in Plenums)
 - b. Stable up to 300 °F (148 °C) continuous exposure
 - c. Insulation shall not absorb water or support microbial growth
 - d. Will not degrade when exposed to UVC light
 - e. Continuous, seam-welded, and held in place without bands or clamps, to minimize surfaces for the accumulation of particulate matter

2.6 HUMIDIFIER ACCESSORIES

A. Drane-kooler™: A thermostatically controlled water valve shall meter an amount of cold water into a stainless steel mixing chamber to temper 212 °F (100 °C) water with a 6 gpm (0.38 L/s) in-flow rate to a 140 °F (60 °C) discharge temperature to sanitary system.

PART 3 — EXECUTION

3.1 INSTALLATION

A. Install per manufacturer's printed instructions and as indicated on drawings.

B. Coordinate electrical connections as specified in Division 26.

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DIVISION 25 09 23 - FACILITY MANAGEMENT AND CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 – Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. This section describes the scope of work for the Facility Management and Control System that shall be provided by a qualified FMCS Contractor and integrated to the Enterprise Server by the Enterprise Developer.
- B. Provide Facility Management and Control System (FMCS) incorporating Direct Digital Control (DDC), energy management and equipment monitoring consisting of the following elements:
 - 1. Microprocessor based remote control panels interfacing directly with sensors, actuators, and environmental delivery systems to provide complete standalone DDC/EMS functionality. (i.e., HVAC equipment, etc.).
 - 2. Communication network to allow data exchange between remote panels and central web supervisor.
 - 3. Interface with existing personal computer (PC) based central and associated operator station(s), and software functioning as the primary operator interface for FMCS. System shall utilize a graphics front end.
 - 4. Pneumatic, electric and electronic control for all items indicated including dampers, valves, panels and pneumatic and electrical installation.
- C. Controls for HVAC Equipment:
 - 1. Controls installer shall interface the FMCS systems with the FMCS panel provided by manufacturer of the HVAC equipment. Control installer shall provide integrator panel and all wiring from FMCS to HVAC equipment for interoperability with LonTalk.
- D. Provide submittals, installation, data entry, programming, startup, test and validation of FMCS, instruction of Owner's representative on maintenance and operation of FMCS, as-built documentation, and system warranty. See Section 1.11
- E. Completely coordinate with work of other trades.
- F. It is the owner's goal to implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).
- G. All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

1.3 INTEGRATION OF HVAC EQUIPMENT AND OTHER PRODUCTS

- A. Packaged rooftop units with modulating gas-fire furnace and direct expansion cooling.
- B. Variable air volume terminals with electric heat.
- C. Electric storm humidifiers.
- D. Hydronic heating coils.
- E. Environmental control unit.

1.4 SCOPE OF WORK

- A. The Facility Management and Control System (FMCS) shall be comprised of Java Application Control Engine or Controllers (JACE) within each facility. The JACE shall connect to the owner's local or wide area network, depending on configuration. Each User shall configure a dashboard view of the pertinent data and this view shall be saved for later use. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through a standard Web browser, via the Internet and/or local area network. Each JACE shall communicate directly to LonMark/LonTalk (IDC), It is the owner's goal to eliminate any gateway or redundant (redundant to the JACE functionality) device(s).
- B. The Facility Management and Control System (FMCS) as provided in this Division shall be the based on the NiagaraN4 Framework, a Java-based framework developed by Tridium
- C. The work provided in this specification shall be performed by multiple entities. The FMCS Contractor shall have overall responsibility for the work. The Enterprise Developer (Noresco) shall be appointed by the Owner and shall provide all work at the Enterprise Server level. Owner will oversee and provide procurement for Enterprise Developer services.
- D. Systems Integrator shall provide overall management, coordination and responsibility for delivering integrated FMCS systems. The Systems Integrator shall review work performed by other Specialty Contractors such as low voltage, IT, security and control system subcontractors and coordinate the connection of these systems to the Owner's IT infrastructure in conjunction with the Owner's IT staff.
- E. All materials and equipment used shall be standard components. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.
- F. All wiring shall be done in accordance with all local and national codes.

1.5 DIVISION OF WORK

- A. The FMCS contractor shall be responsible for all communicating temperature, humidity and pressure sensors, any miscellaneous controllers(IDC and IBC), control devices, control panels, controller programming, and controller programming software, controller input/output and power wiring and controller network wiring specified to be provided in Division 23.
- B. The FMCS contractor shall be responsible for the Java Application Control Engine(s) (JACE), software and programming of the JACE, graphical user interface software (GUI), User Configurable Dashboard software and connection of the JACE to the local or wide area network. FMCS shall also be responsible for development of all graphical screens, Web browser pages, setup of schedules, logs and alarms, and network management for all IDC or IBC devices provided in Division 23 and 26. IDC or IBC devices not provided by FMCS contractor shall be configured and commissioned by appropriate contractor and later managed in the JACE by FMCS contractor.
- C. For reasons of security and consistency, it is the owner's intention to divide the work defined in this section into two sections. Work performed at the JACE level and below shall be performed by a qualified FMCS Systems Integrator. All work provided at the Enterprise Server and between the server and other systems shall be

provided by the owner appointed Enterprise Developer. The Enterprise Developer shall be responsible for the "learning" of the WBI (web browser interface) from the JACE to the Enterprise Server, the configuration of the Periscope Dashboard software and the global integration strategies across JACE s and other intelligent building systems. The Enterprise Developer shall also be responsible for all Security integration at the Server level, if applicable.

1.6 QUALITY ASSURANCE

The FMCS system shall be designed and installed, commissioned and serviced by Factory trained personnel (Niagara N4 Certification or equivalent). FMCS Contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.

- A. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, and Governing Radio Frequency Electromagnetic Interference and be so labeled.
- B. UPS to be installed for 120v feeding power supply to JACE and battery backup option for Jace to also be installed.
- C. System to be installed by competent technicians, with full responsibility for proper operation of FMCS, including debugging and proper calibration of each component in entire system.
- D. Codes and approvals:
 - 1. Complete FMCS installation to be in strict accordance with national and local electrical codes, and Electrical Specification Divisions of these specifications. All devices designed for or used in line voltage applications to be UL listed.
- E. All system components shall be fault tolerant.
 - 1. Provide satisfactory operation without damage at 110 percent and 85 percent of rated voltage, and at +/- 3 hertz variation in line frequency.
 - 2. Provide static, transient, short circuit, and surge protection on all inputs and outputs. Communication lines to be protected against incorrect wiring, static transients, and induced magnetic interference. Bus connected devices to be a.c. coupled, or equivalent so that any single device failure will not disrupt or halt bus communication.
 - 3. All real time clocks and data file RAM to be battery or capacitor backed.
- F. System overall reliability requirement: The system, including all components and appurtenances, shall be configured and installed to yield a Mean Time Between Failure (MTBF) at least 1000 hours.
- G. System accuracy and display: The system shall maintain an end-to-end accuracy for 1 year from sensor to Operator's console display for the applications specified and shall display the value as specified.
- H. All field equipment shall be rated for continuous operation under ambient environmental conditions of 35 to 120 degF dry bulb and 10 to 95 percent relative humidity, noncondensing. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity and vibration conditions specified or normally encountered for the installed location.

1.7 SUBMITTALS

- A. Shop Drawings: Provide individuals experienced with the installation and startup of equipment related to this type of integration.
 - 1. One copy of shop drawings of the entire FMCS shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers catalog data sheets and installation instructions.
 - 2. Complete system design information including:

- a. Data entry forms for initial parameters. All text and graphics to be approved prior to data entry.
- b. Valve, and damper schedules showing:
 - 1) Size.
 - 2) Configuration.
 - 3) Capacity.
 - 4) Location.
- c. Wiring and piping interconnection diagrams, including panel and device power and sources.
- d. Equipment lists (bill of materials) of all proposed devices and equipment.
- e. Software design data including:
 - 1) Flow chart of each DDC program showing interrelationship between inputs, PID functions, all other functions, outputs, etc.
 - 2) Sequence of operation relating to all flow chart functions.
- f. Control sequence.
- g. DDC installation, block diagrams, and wiring diagrams for each piece of equipment.
- h. DDC panel physical layout and schematics.
- i. The network topology diagram shall indicate the location and room number of all DDC controllers.
- j. The FMCS Contractor shall submit an architecture layout that depicts devices from the JACE down to the device level.
- k. The FMCS Contractor shall submit an architecture layout that depicts network diagrams for JACE to JACE communications as well as JACE to Server.
- l. LonWorks specific designs:
 - 1) The FMCS Contractor shall submit a network topology diagram that includes the following on all LON devices
 - a) Neuron IDs
 - b) Routers
- 3. Sequence of Operations: A complete written Sequence of Operation shall also be included with the submittal package. The FMCS Contractor shall coordinate data from other contractors supplying products and systems, as part of their package and shall provide catalog data sheets, wiring diagrams and point lists to the owner for proper coordination of work.
- 4. If a project is considered a renovation project the FMCS Contractor shall update all existing master diagrams in order to keep as-built drawings completely accurate for the entire building.
- 5. Digital Visio updateable drawings should be contained in JACE and Flash drive.
- 6. A copy of all networks must be drawn on the actual physical daisy chain as installed. This is the actual blueprint showing the floorplan, equipment location and the route in which the network was run.
- B. Product Data:
 - 1. Complete list of product data including:
 - a. Data sheets of all products.
 - b. Valve, damper, and well and tap schedules showing size, configuration, capacity, and location of all equipment.
- C. Project Information:
 - 1. Certification of installer qualifications.
- D. Submittal shall also include a copy of each of the graphics developed for the Graphic User Interface including a flowchart (site map) indicating how the graphics are to be linked to one another for system navigation. The graphics are intended to be 80% - 90% complete at this stage with the only remaining changes to be based on

review comments from the A/E design team and/or Owner. Submittal shall also include a copy of the expected Dashboard view lets being provided for owner configuration. It is expected that the successful FMCS Contractor shall utilize the USMA graphic templates as much as possible. The owner will provide an example of an acceptable graphic template. Where a particular graphic template does not exist, the Integrator shall create a similar template and gain approval during submittal process.

- 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™ or Visio™ compatible files.
- F. Contract Closeout Information:
 - 1. Operating and maintenance manuals.
 - 2. Owner instruction report.
 - 3. Certification that Owner Training has been provided by FMCS installer.
 - 4. As Built Instrumentation and Control Diagrams.
 - 5. Plan As-Built at 1/8 inch scale showing:
 - a. 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™ or Visio™ compatible files.
 - b. Two copies of the 'as-built' drawings shall be provided in addition to the documents on compact disk.
 - c. Division 23, 25 and 26 contractors shall provide as-builts for their portions of work.
 - d. The FMCS Contractor shall be responsible for as-builts pertaining to overall FMCS architecture and network diagrams. All as built drawings shall also be installed into the FMCS server in a dedicated directory.
 - e. Communication cable circuiting drawing with DDC panels and communication devices labeled.
 - f. Power wiring circuiting drawing showing 120 volt circuit source and low voltage transformer locations, identifications, and circuit to each controlled device per transformer for the DDC system.
- G. Any software needed to program or calibrate controls system will be provided along with any setup, configurations and data files. Also, any hardware needed to communicate with the controllers and/or devices will also be included.

1.8 JOB CONDITIONS

- A. Cooperation with other Trades: Coordinate the Work of this section with that of other Sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Systems Integrator's responsibility to check the Contract documents for possible conflicts between his work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.9 SOFTWARE LICENSE AGREEMENT

- A. It is the owners' expressed goal to implement into the existing Honeywell WEBS to be integrated into a server in order to provide consistency for expansion, maintenance, and service of the system. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project. This shall include:
 - 1. All custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the JACE, FMCS Server(s), and any related LAN / WAN /Intranet and Internet connected routers and devices.

2. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner.
- B. The Owner has signed a software and firmware licensing agreement with a three (3) year SMA. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. Systems Integrators that participate in the integration of USMA's direct digital control systems must:
 1. Be certified in the use, application and service of Honeywell NiagaraN4 software and shall provide documentation from the manufacturer's training center as such. However, certification in the above does not automatically qualify an integrator to bid on proposed USMA projects. Only approved integrators listed in this specification are eligible to participate in the project.
 2. Agree to use on any USMA application standards, html pages, graphics templates, etc. developed by or for USMA for the purpose of digital control, scheduling, alarming, graphics, etc.
 3. Agree that the application standards, html pages, graphics templates, etc. developed only for USMA (subject to the manufacturer's license agreement) and shall not be reproduced, etc. for use on any other customer, project, etc. without the expressed written permission of the USMA.
 4. Agree that certification on the manufacturer's software does not guarantee continued participation in USMA FMS projects.
 5. Agree to provide USMA with the highest level of administrative password.
 6. Agree that USMA and other Systems Integrators can use the onsite USMA software tools to modify JACEs, license files, passwords, provide software maintenance, etc., after warranty period expires.
 7. The owner requires that all NiagaraN4 based software and hardware on this project have the following Niagara Information Compatibility Statement (NICS). The Existing NiagaraN4 Server complies with the requirements below. Organizations without the NICS below shall not be allowed to bid.
 - a. Brand ID = WEBS
 - b. Station Compatibility In = *
 - c. Station Compatibility Out = *
 - d. Tool Compatibility In = *

1.10 WARRANTY

- A. Provide all services, materials and equipment necessary for the successful operation of the entire FMCS for a period of one years after acceptance by the USMA and provide hardware and software upgrade support during that period that corresponds with any upgrades performed by FM FIS.
- B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the FMCS contractor at no expense to the Owner.
- C. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.
- D. With owner pre-approval, the on-line support services shall allow the local FMCS Contractor remote access to monitor and control the facility's building automation system. Pending owner approval, this remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends and holidays.
- E. Warranty Access

1. Pending owner pre-approval, the Owner shall grant to the FMCS contractor, reasonable access to the FMCS during the warranty period. The owner shall allow the contractor to access the FMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

1.11 ACCEPTABLE SYSTEM CONTRACTORS

- A. The FMCS Contractor shall provide Honeywell hardware, software and Honeywell Spyder DDC components. The successful FMCS Contractor shall not have password access to the Enterprise Server (WEBs Supervisor) and shall be restricted to JACE access.
- B. The FMCS Contractor shall have a technical support group accessible that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
- C. FMCS Systems Contractors using Honeywell hardware and software components must be approved by USMA prior to winning projects.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, network devices and other devices as specified herein.
- B. The installed system shall provide secure passwords access to all features, functions and data contained in the overall FMCS.

2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate the most current LonWorks technology.
- B. The supplied computer software shall employ component-based technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including the most current ANSI/ ASHRAE™ Standard, LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file and a resource file for the device.
- C. All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.
- D. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a UMCS server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.
 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

2.3 MATERIALS

- A. Temperature control system:
 - 1. Include:
 - a. Temperature sensors.
 - b. Humidity sensors.
 - c. Controllers.
 - d. Switches.
 - e. Relays.
 - f. Valves.
 - g. Dampers.
 - h. Damper operators.
 - i. Thermostats.
 - j. Humidistats.
 - k. Hygrometers.
 - l. Other associated controls required to maintain conditions described in detail on drawings, together with thermometers, gauges and other accessory equipment.
 - 2. Provide complete system of wiring and air piping as necessary to fill intent of these specifications.
 - 3. Control sequences indicated illustrate basic control functions only.
 - 4. Provide additional controls required to meet intent of these specifications and make a complete system.
 - 5. Space temperature and humidity control.
 - 6. Control of air handling units.
 - 7. Control of exhaust systems.
 - 8. Control of cooling systems.
 - 9. Control of heating systems.
- B. Control panels. Where electronic sensing is used, furnish amplifier relays and transformer complete with overload protection.
- C. Electrical drawings indicate type of motor control required by equipment.
 - 1. NETWORKS The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and OBIX for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Java Application Control Engine (JACE s), user workstations and, if specified, a local server.
- D. Local area network minimum physical and media access requirements:
 - 1. Ethernet; IEEE standard 802.3
 - 2. Cable; 100 Base-T, UTP-8 wire, category 6
 - 3. Minimum through put; 100 Mbps.

2.4 NETWORK ACCESS AND SECURITY

- A. Remote Access
 - 1. For Local Area Network installations the Owner shall provide a connection to the Internet to enable access via the customer's Intranet to a corporate server. FMCS Contractor shall connect to IP drop provided by the Owner within 25 feet utilizing a minimum of Category 6 grade of patch cabling.
- B. JACE IP communications
 - 1. FMCS Contractor will use DHCP and DNS for IP communications.

- a. No static IPs or “hardcoded” IP addresses in the JACE will be accepted.
 - b. The FMCS Contractor shall request from USMA FIS all required primary port TCP/IP network configuration settings for all JACE s via standard RFI. **The FMCS Contractor shall not assign any of the following configuration settings without FM FIS approval.**
 - 1) Domain name
 - 2) Host name
 - 3) Station Name
 - c. Secondary port
 - 1) For troubleshooting purpose, The FMCS Contractor shall configure the JACE’s secondary port to a static IP address of 192.168.1.12X, where X is equal to last digit of JACE’s serial number.
 - 2) The subnet mask shall be configured to 255. 255. 255.0
- C. Security and Authentication
1. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data.
 2. The Owner shall control/set all passwords and security levels for all operators. The Owner shall provide the FMCS and Enterprise Developer with the standard passwords required to be used in the Enterprise Server and the JACE.
 3. The FMCS Contractor shall not use any passwords except those provided by the owner. The system administrator shall have the ability to set passwords and security levels for all other operators.
 4. The FMCS Contractor shall not leave any default usernames/passwords on the JACE.
 5. Each operator password shall be able to restrict the operators’ access for viewing and/or changing each system application, full screen editor, and object.
 6. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected.
 7. User Profile templates:
 - a. The FMCS Contractor shall program users in the JACE utilizing the following User profiles

User Profile	View Graphics	Operator Setpoints	All Setpoints	Add/Delete Users
Technician	X	X		
View Only	X			
Power User	X	X	X	X

8. SSL requirements
 - a. All communications between Niagara devices and the Enterprise server or user interface software, shall be secured using SSL encryption.
 - b. The following ports shall be used for SSL communications

Software Interface	Protocol	Specified Port
Browser	HTTPS	443
Niagara Station IDE	FOX	4911
Niagara Platform IDE	TSLv1	5011

2.5 JAVA APPLICATION CONTROL ENGINE (JACE)

- A. The FMCS Contractor shall supply one or more Java Application Control Engine (JACE) as part of this contract to manage devices/points in all specification sections. The Systems Integrator shall be required to integrate zone information into the HVAC and Lighting Sequence of Operation. The number of JACEs provided by the FMCS Contractor is dependent on the type/quantity of devices and points. It is the responsibility of the FMCS Contractor to coordinate with all Division contractors to determine the quantity and type of JACEs needed to fulfill the operating sequences.
- B. Java Application Control Engine (JACE) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the JACE. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization
 - 6. Integration of LonWorks controller data and BACnet controller data Software Interface Protocol Specified Port Browser HTTPS 443 Niagara Station IDE FOX 4911 Niagara Platform IDE TLSv1 5011
 - 7. Network Management functions for all LonWorks based devices.
- C. The Java Application Control Engine must provide the following hardware features as a minimum:
 - 1. Two Ethernet Ports – 10/100 Mbps
 - 2. One RS-232 port
 - 3. One LonWorks Interface Port – 78KB FTT-10A (if applicable)
 - 4. One RS-485 port
 - 5. Battery Backup or equivalent
 - 6. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 - 7. The JACE must be capable of operation over a temperature range of 32 to 122°F
 - 8. The JACE must be capable of withstanding storage temperatures of between 0 and 158°F
 - 9. The JACE must be capable of operation over a humidity range of 5 to 95% RH, noncondensing.
- D. The JACE shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.
- E. JACE shall be Webs v.4.8.0.110 by Honeywell.
- F. JACE Alarm Notification and actions:
 - 1. The JACE shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers. The JACE shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 - 2. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
 - 3. Provide for the creation of a minimum of eight of alarm classes (Must contain building name) for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 - 4. Provide timed (scheduled) routing of alarms by building name and class, object, group or node.

5. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
 6. Control equipment and network failures shall be treated as alarms and annunciated.
 7. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text
 - b. Email of the complete alarm message to multiple recipients. Provide the ability to route email alarms based on:
 - 1) Day of week
 - 2) Time of day
 - 3) Recipient
 - c. Graphic with flashing alarm object(s).
 8. The following shall be recorded by the JACE for each alarm (at a minimum):
 - a. Time and date
 - b. Location (building, floor, zone, office number, etc.)
 - c. Equipment (air handler #, access way, etc.)
 - d. Acknowledge time, date, and user who issued acknowledgement.
 - e. Number of occurrences since last acknowledgement.
 9. Alarm actions may be initiated by user defined programmable objects created for that purpose
 10. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
 11. A log of all alarms shall be maintained by the JACE and/or a server (if configured in the system) and shall be available for review by the user.
 12. Provide a "query" feature to allow review of specific alarms by user defined parameters.
 13. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
 14. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
- G. JACE Data Collection and Storage.
1. The JACE shall have the ability to collect data for any property of any object and store this data for future use. See points list for required logs.
 2. The data collection shall be performed by log objects, resident in the JACE that shall have, at a minimum, the following configurable properties:
 - a. Designating the log as interval or deviation.
 - b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 3. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action. All log data shall be archived to a database in the Enterprise Server and the data shall be accessed from a standard Web browser.
 4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL, BQL & NQL statements.

5. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text
 - d. Comma or tab separated values.
6. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
7. The JACE shall have the ability to archive its log data remotely to a server on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a. Archive on time of day
 - b. Archive on user-defined number of data stores in the log (buffer size)
 - c. Archive when log has reached its user-defined capacity of data stores
 - d. Provide ability to clear logs once archive.
- H. JACE Audit Log
 1. Provide and maintain an Audit Log that tracks all activities performed on the JACE. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log to a server. For each log entry, provide the following data:
 - a. Time and date
 - b. User ID
 - c. Change or activity: i.e., Change set point, add or delete objects, commands, etc.
- I. JACE Database Backup & Storage
 1. The JACE shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval. Enterprise Developer shall coordinate with Owner to establish/implement a backup procedure.
 2. Copies of the current database and, at the most recently saved database shall be stored in the JACE. The age of the most recently saved database is dependent on the user-defined database save interval.
 3. The JACE database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.
- J. JACE Time Sync
 1. Use the NtpPlatformServiceQnx in the Station/Services/PlatformServices/ NtpPlatformServiceQnx.
- K. JACE Weather Station/ODA Temperature
 1. The Web Supervisor has a dedicated weather station that will be available through the Niagara Network. While the Jace is not on the USMA Network and for backup purposes all buildings are required to have their own Outdoor Air Temperature sensor to be used for economizer and other requirements but also be able to be overridden by the Web Supervisor Outdoor Air Temperature.
 2. Also available from the Web Supervisor is Outdoor Humidity, Dew point and Wet Bulb.
 3. The weather station in the Services of the Station should also be enable and set for Newburgh, NY
 4. At this time Air Quality is not enable due to conditions beyond our control. Therefor this property should be set to False.
- L. JACE Loading.
 1. USMA desires for the SI to design the system to properly load balance across multiple JACEs. I.e.; USMA does not want 1 Jace operating at 80% and another is operating at 20%

2.6 INTEGRATED DEVELOPMENT ENVIRONMENT (IDE)

- A. It is the intent of USMA to manage and maintain all Niagara devices on the BAS network to the same Niagara approved version (4.8.0.110). It is also the intent of USMA to upgrade the version of Niagara once a year in April. However, an upgrade to Niagara may be performed at any time based upon USMA's discretion. It is the FMCS Systems Contractor's responsibility to check the currently installed/approved version of Niagara campus and to attain and perform any deployment with the current USMA approved version.
- B. An integrated development environment for development of graphic screens, control logic, security, alarm notification and data storage has been established using the Niagara Workbench Tool and currently resides on a Server in the existing data center and several laptops. The successful FMCS Contractor shall utilize its own laptop for all programming and graphical development. The Enterprise Developer shall utilize the IDE at the server via a VPN connection or its own separate laptop IDE. The IDE residing on the central server shall be the most current version of the Niagara Workbench toolset and the FMCS Contractor shall utilize the exact same version when programming JACEs.
- C. The server and JACE IDE tools shall be identical; however, it shall be possible to limit views and commands via a unique user profile and password in either. The IDE shall include a quick viewing of, and access to, the hierarchical structure of the database. Menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills.
- D. System Diagnostics. The system shall automatically monitor the operation of all workstations, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- E. Alarm Management:
 - 1. The system will be provided with a dedicated alarm window or console. Refer to Sequence of Operations/Points List for Alarm strategies. The Alarm Console will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator. Alarms shall be created and grouped per the owner's requirements by the FMCS Contractor at the JACE level. The Enterprise Developer shall bring the JACE alarms into the existing Enterprise server and generate the strategies to send alarms to the appropriate city or contractor parties.
 - 2. Alarms shall be capable of being routed to any of the following:
 - a. Local Alarm Console (by FMCS Systems)
 - b. Remote Alarm Station (by Enterprise Developer)
 - c. Email recipient (multiple if needed) (by Enterprise Developer)
 - 3. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable. Alarms shall be able to be mapped into groupings where the groupings have common displays, sounds or hyperlinks. This grouping shall be used to distinguish alarms when alarms are coming in from multiple sites or classes (i.e. buildings, regions, trades, etc) for faster recognition.
 - 4. The system shall be provided with an alarm database management view. The view shall allow a user with appropriate password to:
 - a. Filter or Clear old records before a certain date and time
 - b. Clear records older than the currently highlighted record
 - c. Clear all records

- d. Modify the alarm table options including which alarm details are displayed, column width, etc.
- e. Export the alarm database records to .pdf, text or CSV formats.
- f. There will be 4 Alarm Classes, Critical Alarms Class, Non Critical Alarms Class, Maintenance Alarms Class and Network Alarm Class.

2.7 WEB BROWSER CLIENTS

- A. The system shall also allow use of an unlimited number of clients using a standard Web browser including Chrome and Firefox™ (preferred). The system shall be capable of providing a rich user experience (including full use of the engineering toolset) through the use of java applets or a simple user interface using only HTML, CSS and JavaScript. Refer to Sequence of Operations for the client side display types that are required on this project.
 - 1. Acceptable Browsers:
 - a. Firefox™
 - b. Google Chrome
 - c. Microsoft Edge
- B. The Web browser shall provide the same view of the graphics, schedules, calendars, logs, etc. asks provided by the Graphical User Interface and match the look and feel of graphics in the Web Supervisor. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
 - 1. The Web browser client shall support at a minimum, the following functions:
 - 2. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
 - 3. Graphical screens developed for the GUI shall be the same screens used for the Web browser client (unless clearly stated in the sequence of operation). Any animated graphical objects supported by the GUI shall be supported by the Web browser interface. Enterprise Developer shall provide a FMCS Contractor with a basis of performance/expectation for GUI. FMCS Contractor shall use this standard graphic template or modify the graphics slightly to achieve the desired specification requirement/outcome.
 - 4. Storage of the graphical screens shall be in the Java Application Control Engine (JACE) and these graphics shall be “learned” by the Enterprise Server via **Export tagging**.
 - 5. Jace will be set up for Export Tagging to following proper Niagara standards.
 - 6. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
 - 7. Owner shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
 - 1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.

- c. View logs and charts
 - d. View and acknowledge alarms
 - e. Setup and execute SQL queries on log and archive information.
8. The system shall provide the capability to specify a user's (as determined by the logon user identification) home page. Provide each specific user a defined home page based on their usage requirements. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
 9. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
 10. Graphics on JACE shall not have more than 2 tabbed panes and have a "load" time not exceeding 5 seconds.
 11. Navigation page will follow this layout;
 - a. Home page – Main landing page with menu and a picture of the building.
 - b. Floor plans, under floor plans folder are the individual floor plans and under them the individual VAV's (meters and lighting to be shown on floor plan with layers and a legend.)
 - c. Systems
 - d. Equipment
 - e. Alarms
 - f. Schedules
 - g. Meters
 - 1) Power
 - 2) Water
 - 3) Gas
 - h. Documents (PDFs and Visio files)
 12. Alarms are required when network or controllers go down.
 13. Alarms shall include out of range source information.
 14. All PID set point adjustments on a secure/hidden graphic. This file will be restricted by the system administrator.
 15. Autotune is not acceptable and will be disabled.
 16. Network punch down blocks are required.
 17. All floorplans to in a SVG or Scalable Vector Format.
 18. Layouts shall be designed for screen Resolution 1366x800
 19. VAV summary Page - Room Temp, Act temp, set point, damp position, reheat valve position, supply air temp, override color
 20. Page for Max Terminal Box used for Set Point Calculation to allow for step up or step down of air flow. Ability to disable and enable vav boxes in calculation
 21. Show what points are in override, down, stale, in Alarm, and fault.
 22. Label units (ahu) to show what they feed
 23. Network diagram to show jace network inter-connectivity
 24. Jaces to use local outside air temp and server global outside air for temperatures
 25. Valves need to be labeled and position shown.
 26. All flow meters and temperatures need to be trended
 27. Page to show sequences tcva tcb valves

- 28. Page definitions with standards - AHU, CHW, Floorplan, VAV pages, DHW summary page, VAV summary page, water and gas meter page, electric meter
- 29. Insert maps (key plan) when zoomed in floor plans
- 30. Thermostat box on vav page
- 31. Lighting floor plan
- 32. Show where meters are in the building, show icon on floor plan and link back to summary page.
- 33. Floorplan zones - don't use conflicting colors
- 34. Control diagram show network addresses for each device
- 35. Control valve Tuning required on the graphics.
- 36. DomHW.px water temp, tank name
- 37. PX page naming convention
- C. JACEs shall be on Niagara 4.8 at a minimum or at the latest version Niagara that USMA is running on the web supervisor. Check with USMA Facilities Information Systems.

2.8 SERVER FUNCTIONS & HARDWARE

- A. Provide a general, intuitive navigational path from the server to the JACEs. Store all required O&M data sheets, drawings, help files, etc on the server from the USMA approved Web Supervisor Contractor (Noresco).
- B. All JACEs to be JACE 8000s Honeywell only jaces.

2.9 SYSTEM PROGRAMMING

- A. The Jace's Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of controllers need to be accessible through the Jace/GUI through password access as assigned by the system administrator.
- B. Honeywell Platinum graphics, application, and components shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control components from the library, dragging or pasting them on the screen, and linking them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display components to the application components to provide "real-time" data updates. Any real-time data value or component property may be connected to display its current value on a user display. Systems requiring a separate software tool to create applications and browser user interface displays shall not be acceptable.
- C. Programming Methods:
 - 1. Power Fail Protection - All System set points, proportional band, control algorithms and any other programming parameters shall be stored such that a power failure of any duration does not necessitated reprogramming the ASC or FPC.
 - 2. Provide the capability to copy components from the supplied libraries, or from a user defined library to the user's application. Component shall be linked by a graphical linking scheme by dragging a link from one component to another. Component links will support one-to-one, many-to-one, or one- to-many relationships. Linked components shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to components on other pages

for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.

3. Configuration of each component will be done through the component's property sheet using fill-in the blank fields, list boxes, and selection buttons requiring the use of custom programming, scripting language, or a manufacturer-specific procedural language for every component configuration will not be accepted.
 4. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
 5. All programming shall be done in real-time. Systems requiring the uploading, editing, and downloading of database components shall not be allowed.
 6. The system shall support component duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.
 7. All PIDs shall have adjustable set point exposed to the graphics in a secure/hidden page.
- D. Network and Device Naming Conventions.
1. All Network names will not have spaces or underscores. I.e.; LonNetwork is acceptable.
 2. Device names will not have spaces, underscores are acceptable. VAVs must have a room name associated with it. I.e.; VAV1_1Rm126. The #1 after VAV corresponds with the floor it is on and the digit after the underscore identifies the VAV.
 3. All Network and Device names must be kept to a minimum and subject to USMA acceptance.

2.10 COMPONENTS LIBRARIES

- A. A standard library of components shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
- B. The components in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group components created in their application and store the new instances of these components in a user-defined library.
- C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated components and applications as they are developed.
- D. Contractor will use the Niagara template station file as provided by FM FIS. The template station will be made available to the FMCS Contractor upon request via standard RFI.
- E. Contractor shall not use any "non-standard" or OEM JAR files unless approved by FM FIS. A JAR is considered "non-standard" if it is not included in Tridium's "Niagara AX Developer" release made available to developers and to OEM partners. A current list of approved JARs will be made available to the FMCS Contractor upon request via standard RFI. Source codes made available to FIS to store and use.
- F. Any approved non-standard JAR files become property of USMA with a copy of the source code to store and use.
- G. All control components shall conform to the control component specified in the LonWorks specification.
- H. The component library shall include components to support the integration of devices connected to the Java Application Control Engine (JACE). At a minimum, provide the following as part of the standard library included with the programming software:

1. LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific components to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.
2. For devices not conforming to the LonMark standard, provide a dynamic component that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.

2.11 LONWORKS NETWORK MANAGEMENT

- A. The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as “binding”. Systems requiring the use of third party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
- D. These tools shall provide the ability to “learn” an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Java Application Control Engine (JACE), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.
- F. All LonNetworks must be installed to industry standards and are not exceed a max length of 3500 ft. Wire is to be installed in separate conduit if non-plenum and installed in accordance with proper Lon specifications, no more than 60 devices and no Lon repeaters, point and trend counts to assure proper polling of devices and points. Plenum cable is allowed without conduit with University approval. All points and devices are required to update correctly and not go into fault, stale or offline. Proof of network reliability by means of but not limited to LonNetwork Scan tool, Oscilloscope and Polling Service. Copies of these operations are to be submitted to USMA before warranty period begins.

2.12 COMMUNICATING THERMOSTATS

- A. The manufacturer of the Thermostat hardware and software components must be primarily engaged in the manufacture of BAS as specified herein, and must have been so for a minimum of five (5) years.
- B. The manufacturer shall be ISO 9001:2000 certified. This is to insure that all manufacturing, design and support policies comply with a minimum quality assurance standard. Corporate quality assurance policies should be available for examination upon request by the owner or his agent.

- C. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
- D. Communicating Thermostats shall be LON or BACnet thermostats. FMCS Contractor shall standardize on a single protocol for all thermostats and IDC/IBCs (if non thermostat controllers are needed) provided, i.e. all controllers provided shall be of the same protocol. This does not necessarily apply to controllers provided in other sections of the specification as there may be limited choices, but when possible, standardize on a single protocol
- E. Acceptable providers of the Communicating Thermostat hardware and software components as specified herein are as follows. Acceptance as a product provider does not provide approval to be an acceptable FMCS Systems Integrator.

2.13 LON DEVICES

- A. The manufacturer of the hardware and software components must be primarily engaged in the manufacture of BAS as specified herein, and must have been so for a minimum of five (5) years.
- B. The manufacturer shall be ISO 9001:2000 certified. This is to insure that all manufacturing, design and support policies comply with a minimum quality assurance standard. Corporate quality assurance policies should be available for examination upon request by the owner or his agent.
- C. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
- D. Acceptable manufacturers of the DDC hardware and software components as specified herein are as follows. Acceptance as a product manufacturer does not provide approval to be an acceptable FMCS Systems Integrator.
- E. Communicating Thermostats shall be LON thermostats. FMCS Contractor shall standardize on a single protocol for all thermostats and IDC/IBCs (if non thermostat controllers are needed) provided, i.e. all controllers provided shall be of the same protocol. This does not necessarily apply to controllers provided in other sections of the specification as there may be limited choices, but when possible, standardize on a single protocol
- F. Acceptable manufacturers of the VFD hardware and software components as specified herein are as follows. (ABB VFD or equivalent) acceptance as a product manufacturer does not provide approval to be an acceptable FMCS Systems Integrator.

2.14 THIRD PARTY INTEGRATION

- A. The Java Application Control Engine shall support the integration of device data from the existing control system. The connection to the existing system shall be via an RS-232 or RS485 connection between the Java Application Control Engine and the existing control system {if applicable on this project}.
- B. Provide the required data points from the third party integration per sequence of operations and/or points list.
- C. All Third Party Networks must be installed to industry standards with attention to number of devices, routers, and overall length, point and trend counts to assure proper polling of devices and points. All points and devices are required to update correctly and not go into fault, stale or offline. Proof of network reliability by means of but not limited to Scan tool, Oscilloscope and Polling Service. Copies of these operations are to be submitted to USMA before warranty period begins.

2.15 SENSORS (Honeywell, Veris & Johnson Controls)

- A. All control items, except thermostats, sensors and transmitters located in rooms shall be properly identified with engraved plastic nameplates permanently attached. Name plates shall have white letters on a black background.
- B. All sensors shall be provided in NEMA 4X enclosures where exposed to the Pool environment.
- C. Room thermostat, sensor and transmitter locations shall be coordinated to align vertically or horizontally with adjacent light switches or other control devices. Room thermostats and sensors shall be mounted with the bottom 5'-0" above the floor. Sensors installed in areas where they are subject to physical abuse (ex: gymnasiums) shall be furnished with protective type aspirating guards. Sensors installed on exterior walls shall be installed on non-conductive (cork) sub-base. Sensors shall have plus or minus local set point control feature.
- D. Temperature Sensors: Thermistor type with an accuracy of plus or minus 0.40 degree F over the entire control range. Sensors for pipe installations shall be immersion type, brass well, and thermistor with integral lead wire. Sensors for duct application shall be insertion probe type, stainless steel probe, integral handibox, and thermistor with integral lead wire. Space temperature sensors shall be compatible with the unit controller and shall be provided in a decorative metal or plastic enclosure (Nema 4X where exposed to pool environment). Space temperature sensors shall be provided with set point and temperature indication only. Outdoor temperature sensors shall be mounted inside a protective weather and sun shield and shall be located on a North wall.
- E. Humidity Sensors: Thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%), 12 - 30 VDC input voltage, analog output (0 - 10 VDC). Operating range shall be 5 to 95% RH and -40 to 170 degree F. Duct mounted type sensors shall have a stainless steel insertion element, sealed to prohibit corrosion. Sensors shall be selected for wall, duct or outdoor type installation as appropriate.
- F. Carbon Dioxide Sensors (CO2): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 50 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC/DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure required in all classrooms and labs.
- G. Differential Air Pressure Switch: Differential pressure switches for proving fan operation or sense dirty air filters shall be SPDT type, UL approved, and selected for the appropriate operating range of the equipment to which it is applied. Sensor shall have 1/4" compression type fittings and shall have an adjustable set point. Furnish with 1/4" barbed type static pressure tips.
- H. Current Switches (Type 1): For proving fan or pump operational status, provide solid or split-core type current status switches with adjustable set point and solid-state internal circuitry. Current switch shall have induced power, trip point set adjustment to plus or minus 1% over a range of 1 to 135 amps, trip and power LED, and field adjustable to indicate both On-Off conditions and loss of load (broken belt, etc.). Units shall have a five-year manufacturer's warranty.
- I. Current Switches (Type 2): For proving fan or pump operational status, provide solid or split-core type current switches ("Go/No" type). Current switch shall have induced power, 100 percent solid state with no moving parts. Units shall have a five-year manufacturer's warranty.
- J. Low Temperature Sensors: For sensing low temperatures in air handling units, provide SPST type switch, 35 to 45 degree F range, manual reset, vapor charged twenty foot long sensing element, and 120-volt electrical power connection.

- K. Pressure Transmitters: For sensing static pressure in a duct system (usually for VAV systems), provide a pressure transmitter with integral capacitance type sensing action, solid state circuitry, accuracy of plus or minus 1% of range, zero and span adjustments, 10 to 35 VDC operating voltage, 4 to 20mA output, and integral inlet port connections. Select pressure range suitable for the application.
- L. Line Voltage Thermostats: For control of equipment using line voltage on-off thermostats (exhaust fans, unit heaters, etc.) provide 120 volt UL Listed wall mounted thermostats. Thermostat shall have a range of 50 to 90 degree F with minimum 2 degree F differential, snap acting switch, and dial adjustment for temperature setting.
- M. Firestat: For sensing sudden increases in duct temperature (ex: fire condition), provide 120 volt UL Listed SPST switch with adjustable setpoint that breaks the circuit on a rise in temperature above the setpoint and de-energizes the air handling unit fan.
- N. Aquastat: For sensing temperature of a fluid within a pipe system, provide 120-volt SPST strap-on type aquastat, temperature control range of 100 to 240 degree F (adjustable).
- O. Air Flow Monitoring Device:
 - 1. Provide airflow/temperature measurement devices(ATMD) where indicated on the plans. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.
 - 2. Each ATMD shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor assemblies.
 - a. Each sensor assembly shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
 - b. Thermistors shall be mounted in the sensor assembly using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment.
 - c. The airflow rate of each sensor assembly shall be equally weighted and averaged by the transmitter prior to output.
 - d. The temperature of each sensor assembly shall be velocity weighted and averaged by the transmitter prior to output.
 - e. Each transmitter shall have a 16-character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics.
 - 3. All Sensor Probes
 - a. Each sensor assembly shall independently determine the airflow rate and temperature at each measurement point.
 - b. Each sensor assembly shall be calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - c. Airflow accuracy shall be +/-2% of Reading over the entire operating airflow range.
 - 1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
 - d. Temperature accuracy shall be +/-0.15° F over the entire operating temperature range of -20° F to 160° F.
 - e. The operating humidity range for each sensor probe shall be 0-99% RH (noncondensing).
 - f. Each sensor probe shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.

- g. Each sensor assembly shall not require matching to the transmitter in the field. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter for each measurement location.
- 4. Duct and Probes
 - a. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tube. All wires within the aluminum tube shall be Kynar coated.
 - b. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
 - 1) Insertion mounted through the side or top of the duct
 - 2) Internally mounted inside the duct or plenum
 - 3) Standoff mounted inside the plenum
 - c. The number of sensor housings provided for each location shall be as follows:

Total #

Duct Area (sq.ft.)	Sensors / Location
< 2	4
2 to < 4	6
4 to < 8	8
8 to < 16	12
>= 16	16

- d. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.
- 5. Fan Inlet Probes
 - a. Sensor assemblies shall be mounted on 304 stainless steel housings.
 - b. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
 - c. Mounting feet shall be constructed of 304 stainless steel.
 - d. The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.
- 6. Transmitters
 - a. The transmitter shall have an integral LCD display capable of simultaneously displaying airflow and temperature. The LCD display shall be capable of displaying individual airflow and temperature readings of each independent sensor assembly.
 - b. The transmitter shall be capable of field configuration and diagnostics using an on-board pushbutton interface and LCD display.
 - c. The transmitter shall have a power switch and operate on 24 VAC (isolation not required).
 - 1) The transmitter shall use a switching power supply fused and protected from transients and power surges.
 - 2) The transmitter shall use "watch-dog" circuitry to assure reset after power disruption, transients and brown-outs.
 - d. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.
 - e. The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be installed at a location that is protected from weather and water.

- f. The transmitters shall be capable of communicating with other devices using the following interface option: Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0-10VDC/4-20mA (4-wire)
- 7. The ATMD shall be UL listed as an entire assembly.
- 8. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans.

2.16 DAMPERS AND ACTUATORS (Honeywell or Belimo)

- A. Damper actuators shall be sized by the **FMCS Contractor** for the intended application. Unless noted otherwise, dampers will be furnished by the **FMCS Contractor** for all field installed dampers that are not included as part of the equipment. In general, provide opposed blade type dampers for modulating control and parallel type dampers for two position control applications.
- B. Control Dampers. Provide all automatic control dampers not specified to be integral with other equipment. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the airstream. Blades shall not be over 8 inches wide nor less than 16-gauge galvanized steel triple V type for rigidity. Bearings shall be acetal, nylon or ball-bearing with ½ inch diameter plated steel shafts. Dampers shall be suitable for temperature ranges of -40 to 180F. All proportional control dampers shall be opposed, or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. wc. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. wc. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. wc. Side seals shall be stainless steel of the tight-seal spring type. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal. Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC. Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage. Testing and ratings shall be in accordance with AMCA Standard 500. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.
- C. Damper Actuators: Damper actuators shall be provided for all automatic dampers. Damper actuators controlled through the DDC system shall be low voltage electronic type, either modulating or two-position, as required to achieve the intended sequence of operation. Provide with spring return when required for fail-safe operation. Modulating dampers shall be positive positioning in response to a 2 – 10 VDC control signal. Actuator shall include the capability of adding auxiliary switches for position indication. Furnish actuators other than spring return type with a release button (clutch) or handle on the actuator to allow for manual override. Power supply to the actuator shall be by 120 VAC, 24 VAC, or 24 VDC and the actuator shall be furnished with a factory installed 3-foot cable with end fitting for field connection. All actuators shall be UL Listed by the manufacturer.

2.17 CONTROL VALVES

- A. Control Valves: (Globe Type) Valves shall be Honeywell 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Two-way water valves shall have equal percentage flow characteristics and three-way valves shall have equal percentage flow characteristics straight through and linear through the bypass. Provide valve position indicator on all valves. Leakage rate shall be no more than 0.05% of Cv.
 - 1. Valves 1/2 inch through 1 1/2 inch shall be screwed pattern except where solder connections are specified for valves 1/2 or 3/4 inches. Three-way valves bypass port shall be of one size reduced Cv to preclude the need for a bypass port balancing valve. Valve and cartridge replacement tool shall be configured for maintenance or replacement without draining the coil to prevent water spill; however, an integral isolation valve on the control valve outlet will also be acceptable. Valves shall close off against 58 psi minimum.
 - 2. Two inch valves shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration and ANSI-rated to withstand the pressures and temperatures encountered. Valves shall have stainless-steel stems and spring loaded Teflon packaging with replaceable discs.
- B. Control Valves: (Characterized Ball Valves) Control valves 1/2 to 2 inches shall be 2-way or 3-way forged brass screwed pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Two-way water valves shall have equal percentage flow characteristics and three-way valves shall have equal percentage flow characteristics straight through and linear flow through the bypass. Leakage rate shall be ANSI Class IV (no more than 0.01% of Cv). Valves shall be rated for no less than 350 psig at no less than 250 degrees F. provide a removable handle to operate valves manually during actuator power loss or failure.
- C. Two-way valves shall close off against 100 psi minimum, and three-way valves shall close off against 40 psi minimum. Valves shall have stainless-steel or chemically nickel-plated brass stem and throttling port. Valves shall be tagged with Cv rating and model number.
- D. Butterfly Control Valves: Valves shall be Honeywell or equivalent. Where specified butterfly control valves over 2" in size shall be cast iron body type for 2-way or 3-way applications specified constructed for tight shutoff and shall operate satisfactory against system pressures and differentials. Valves shall have tapped lugs for standard flange connection, and designed for isolation and removal of downstream piping at full rated pressure. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings). Valves shall be rated for bubble tight shutoff at no less than 150 psi. Valve disc shall be aluminum bronze. Valve stems shall be stainless steel, with inboard top and bottom bronze bearings, and an external corrosion resistant top bearing to absorb actuator side thrust.

2.18 ELECTRICAL MISCELLANEOUS

- A. Panels: All enclosures for DDC controllers and devices shall be fabricated in accordance with UL Standards from code gauge steel. Enclosures shall be provided with a continuous hinge on the door and a flush latching mechanism. Enclosures shall be shop painted with standard grade enamel coating. Back panels shall be furnished when required to facilitate installation of boards or accessories. All enclosures installed outdoors shall be constructed to NEMA 3R standards. All controllers shall be installed within an approved enclosure

unless the controller will be installed within the control cabinet section of the equipment that it is intended to control. Enclosures shall facilitate the mounting of gauges, switches, pilot lights, and the like, on the face panel when required. Control devices that are mounted on the face of the panel shall be identified with engraved nameplates.

- B. Power Transformers: Step-down power transformers shall be provided for all DDC controllers and associated accessory devices as required. Transformers shall be sized and selected to accommodate all connected accessory items. Transformers shall be UL Listed Class 2 type with 120 VAC primary, 24 VAC secondary.
- C. Relays: Miscellaneous control relays shall be provided as required to energize or control equipment and devices within the control system. Relays shall be located as close as practical to the controlled device (motor, motor starter, etc.). Where approved by NY State Building Codes, relays may be installed within starters and equipment control panels where space is available. Relays installed outside of the controlled device shall be provided with a NEMA enclosure suitable for the location where installed.

2.19 ELECTRICAL AND COMMUNICATION WIRING

- A. Wiring: All wiring devices and accessories shall comply with the requirements of NY State Building Codes. All wiring shall be installed in a neat and professional manner. Control wiring shall not be installed in power circuit conduits or raceways unless specifically approved for that purpose. All wiring, except plenum wiring (where allowed), shall be run in electrical conduits. Plenum cable will be allowed in concealed locations where accessible. All cable must be installed with 90° angles and strapped according the NY State Building Codes.
- B. Provide all interlock and control wiring. Provide wiring as required by functions as specified and as recommended by equipment and device manufacturers to achieve the specified control functions.
- C. Low voltage conductors shall be stranded bare or tinned-copper with premium grade polymer alloy insulation. For shielded cable, furnish multi-conductor of overall polyester supported aluminum foil with stranded tinned copper drain wire to facilitate grounding. Coaxial shield shall be copper braided type. Provide shielded cable where recommended by the equipment or device manufacturer, grounded in strict accordance with the manufacture's recommendations.
- D. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Terminations for Fire Alarm Control Panel (FACP) interface shall be accomplished by the Electrical Contractor or his designated subcontractor.
- E. FMCS Contractor shall provide power for all control devices and components from the closest available power source or as indicated on the power Drawings. When acceptable to the equipment manufacturer, low voltage power may be obtained from the internal equipment power source or transformer. Electrical Power for Systems Contractor's use has been provided at j-boxes located on plans.

2.20 AV CONTROL ROOM

- A. AV Control Room room shall be monitored with a minimum of temperature and humidity. Temperature shall be shown on the floor plans. Humidity Alarm - below 30% or above 70% and Temperature Alarm - when over 80°F.
- B. Environmental control Unit shall be provided with an integration card to communicate with the BAS system for alarm monitoring.

PART 3 -EXECUTION

3.1 GENERAL

- A. The Facility Management and Control System (FMCS) shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner; including all labor not noted in the "Work by Others" paragraph of Part I of this section of these specifications, and not noted in other sections of these specifications.

3.2 SEQUENCE OF OPERATION

- A. General:
 - 1. HVAC systems shall be controlled with Direct Digital Control (DDC) according to sequence contained in this section of specifications and shall be stand-alone.
 - a. Additional points or software programming not listed but which are required to meet following sequences of operation shall be provided.
 - 2. House controllers, relays, transducers, and other components required for stand alone control in NEMA 1 enclosure with lockable door.
 - 3. All VFD's shall be monitored by FMCS for trouble conditions. Signal shall be a set of dry contacts wired to BAS. Operator will use VFD control panel for diagnostics.
 - 4. Set points:
 - a. All set points given in the sequence of operations or in the drawings are for system startup and are preliminary. Optimum operating set points must be determined during actual occupancy and will be affected by many factors. These may include:
 - 1) Weather conditions.
 - 2) Building occupancy.
 - 3) Building utilization patterns.
 - 4) Variations in building construction.
 - 5) Variations in operating characteristics of actual installed building equipment.
 - b. It is the responsibility of the building operators to determine those settings and operating methods which provide the best balance of operating efficiency and occupant comfort. This is an ongoing process. Optimum settings change as operating conditions change.
 - c. Current switches for motor starters shall be set to indicate failure of motor, for motors with VFDs, the setting shall be below normal minimum operating point. For belt driven motors, the setting shall be capable of detecting belt breakage.
 - 5. The position of all valve and damper actuators shall be communicated to the FMCS.
 - a. Modulating actuators: Utilize feedback signal integral to actuator (or equivalent external device).
 - 6. Two position actuators: Utilize auxiliary contacts integral to actuator (or equivalent external device) to indicate full open position. Full closed position shall also be indicated where specifically required by sequence of operation.
 - 7. Position feedback shall not be required for air terminal unit, unit heater, or fan coil unit actuators.
 - 8. Where space temperature sensors have set point adjustment and unoccupied mode override button, the unoccupied mode shall be overridden to occupied mode of operation for one hour (adj.), unless specified otherwise.
 - 9. Standalone Operation

- a. All DDC controllers that are attached to the FMCS must operate in a “standalone/Occupied” fashion during the loss of communications on any Ethernet network, serial subnetwork, supervisory system, subsystem or peer system
 - b. All DDC controllers shall revert to the stand-alone mode upon detecting a loss of communication with the relevant system for more than 5 minutes (adj.).
 - c. If it is not equipped with a RTC
 - 1) The unit shall default to occupied mode.
 - d. If equipped with a RTC
 - 1) The controller shall revert to a default schedule residing in the DDC controllers programming logic.
 - 2) The FMCS Contractor shall submit the default stand-alone schedule to the owner for approval during the submittal process.
 - 3) The last value (preferred) or a hardcoded default value shall be used for all set points to maintain acceptable operational levels during communication outages.
10. All Utility Metering History Points: All points that are used for metering and/or are being used in a calculation that is being collected in history shall have the transient flag removed. The Transient Flag Removal program will be provided to installing contractor by FIS Control Dept.
11. Sequence of operation for equipment will be provided by the Universities DOR (Designer of Records)

3.3 OWNER TRAINING

- A. General: Owner training shall be executed in four phases. The System Integrator will provide at no cost to the owner, Phase I, Phase II, Phase III and Phase IV training classes. A proposed training agenda will be submitted to the Commissioning Agent in writing, and approved by the Commissioning Agent before the training takes place.
1. The first phase shall take place at the customer job site and will be scheduled at a time preceding owner acceptance. The purpose of the training is to provide an introduction and an overview of the FMS, and ensure owner’s laptop is updated with control tools (software and cabling) and functional with installed controllers. (Phase I and Phase II may be combined.)
 2. The second phase of training shall be a follow-up training to address specific building system and questions of the operators. Training shall take place at the customer job site and will include a site-specific walk through and hands on site-specific instruction. Completion of this training shall be a condition of system acceptance.
 3. Phase III and Phase IV training shall be provided as a follow-up and enrichment to the introductory and site-specific training.

3.4 PHASE I – ON SITE TRAINING

- A. This training will be primarily a classroom lecture/demonstration of approximately 1 hour to give the operator with little or no experience an introduction to the FMS. Presentation materials (PowerPoint, handouts) must be provided to the commissioning agent. Phase I may be combined with Phase II.
1. Building automation fundamentals.
 2. System architecture and functions as they pertain to the site.
 3. System access using the Browser User Interface and FMS software.
 4. Example of basic software controller programming and tuning.
 5. Editing parameters such as set points and schedules.

6. Developing trends and day to day system monitoring.
7. Troubleshooting tools. (Correlation of graphic display to sequences.)
8. The complete range of hardware and software products.
9. Building walk-thru.

3.5 PHASE II – ON SITE TRAINING

- A. The manufacturer and the controls contractor shall provide 6 hours of on-site training in the maintenance and operation of the installed system for up to (4) personnel. The training shall be documented and a syllabus and O&M manuals shall be submitted and approved by the commissioning agent 2 weeks prior to the training. The training should include the following:
 1. HVAC systems layout including the locations of air handlers, DDC controllers, VAV boxes, pumps. This will include a walk-thru at the building.
 2. Review of O&M manual and control system as-builts:
 - a. Using As-Built documentation, Sequences of operation, control drawings, input/output summaries.
 - b. Field sensor and actuator location and maintenance.
 - c. Field controller location and maintenance.
 - d. FMS hardware operation and maintenance.
 - e. FMS software site specific capabilities.
 3. Sequence of operations for each control loop.
 4. Operation and troubleshooting including:
 - a. Modification of ASC or FPC setpoints, parameters, etc.
 - b. Calibration and adjustment.
 - c. Trending.
 - d. Hands on training in the troubleshooting and replacement of components including sensors, transmitters, control valves and actuators. Contractor shall have examples of each component and demonstrate measurement of input and output signals, and any operator adjustments available.
 - e. DDC controller functions and operation.

3.6 PHASE III – ON SITE TRAINING

- A. No later than 6 months and no earlier than 4 months from building acceptance, the SI will repeat Phase I and Phase II training. Training to be consolidated into one 4 hour session.

3.7 PHASE IV – ON THE JOB TRAINING

- A. SI and/or controls contractor shall coordinate all site visits and provide opportunity for university personnel to receive OJT during warranty work. Additionally, provide 2 days of OJT control loop tuning with owner utilizing owner laptop.
- B. The DDC contractor shall provide an additional 4 hours on-site training session twelve (12) months after project completion. The purpose of the session will be to review any operational problems that have developed. In addition, the contractor will lead Facilities Operations personnel through a comprehensive annual preventative maintenance of the controls system. This shall be scheduled at least one (1) month in advance.

3.8 WARRANTY ACCESS

- A. The Owner shall grant the Contractor, reasonable access to the BAS system during the warranty period. The owner shall provide at no cost to the contractor web browser access (VPN) for remote service and troubleshooting during warranty period.

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SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 REFERENCES

- A. Reference Section 23 0513 for all motors being furnished and/or provided by the Electrical Contractor.

1.3 INSTRUCTIONS AND GENERAL REQUIREMENTS

- A. The word "Owner" shall mean West Point Association of Graduates and United States Military Academy or their representative on this Project.
- B. The word "Contractor" shall mean the Contractors responsible for the Electrical Work and who shall perform the work as described herein and indicated on the drawing with respect to the trade.
- C. The word "Design Professional" or "The Design Professional" shall mean the Architect and/or Engineer.
- D. The term "Furnish" shall mean to obtain and supply to the job site. The term "install" shall generally mean to fix in position and connect for use. Where language indicates that one party or trade is to "install" and another is to "connect", the term "install" shall mean only to fix in position, and "connect" shall mean to make final connections to. The term "Provide" shall mean to furnish and install.
- E. It is the intent and purpose of these specifications and accompanying drawings to cover and include each item, all materials, machinery, apparatus, and labor necessary to properly install, equip, adjust, and put into perfect operation the respective portions of the installations specified and to so interconnect the various items or sections of the work as to form a complete and properly operating whole.
- F. Any equipment, apparatus, machinery, material and small items not mentioned in detail, and labor not hereinafter specifically mentioned, which may be found necessary to complete or perfect any portion of installation in a substantial manner, and in compliance with the requirements stated, implied or intended in these specifications shall be furnished without extra cost. This shall include all materials, devices or methods peculiar to the machinery, equipment, apparatus, or systems furnished and installed as part of the Electrical work

- G. Drawings and specifications have been prepared with best knowledge of conditions available at the time of design. If any obscurities or discrepancies exist, they shall be brought to the attention of the Design Professional before bids are submitted. If they are not discovered before bids are submitted, the Design Professional shall be notified and shall render decision. This decision shall be final.
1. Drawings and Specifications are intended to be complementary; items described or shown in one but not both are to be furnished as if fully shown or described in both locations.
- H. The Contractor shall carefully examine all drawings, specifications and contract documents, and the site before submitting his proposal for this work. The Contractor shall compare the site with drawings, specifications and contract documents for all other branches of the work. He shall include in his proposal any monetary sums which he may deem necessary to cover the difficulties and/or costs for furnishing and installing complete all of the work shown on the drawings, the specifications and/or implied therein.
- I. It is the intent of the Contract Documents to describe a functionally complete Project to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be provided whether or not specifically called for at no additional cost to Owner.
- J. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated in the Contract Documents.
- K. Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to The Design Professional any conflict, error, ambiguity, or discrepancy which Contractor may discover and shall obtain a written interpretation or clarification from The Design Professional before proceeding with any Work affected thereby.
- L. If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall promptly report it to The Design Professional in writing.
- M. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and The Design Professional, and the officers, directors, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of The Design Professionals, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible, or by Owner.

- N. The Design Professional will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to The Design Professional in writing within 30 days of the event giving rise to the question
- O. The Design Professional will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- P. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish The Design Professional the required certificates of inspection or approval.
- Q. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and The Design Professional's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and The Design Professional.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall, before submitting his proposal, visit the site of the work and acquaint himself with all conditions relevant to the work and its surroundings. The Contractor shall carefully investigate to determine any variances between actual conditions at site as shown or represented in the specifications or drawings. Anything in the contract documents or any representations, statements, or information made or furnished by The Design Professional notwithstanding, the Contractor shall, regardless of any such conditions relevant to the work, the site of work or its surroundings, assume full and complete responsibility thereof, and all risk in connection therewith at no additional cost to the Owner.
- B. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- C. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and The Design Professional except under extraordinary circumstances. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.
- D. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary

facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

- E. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by The Design Professional, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- F. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

1.5 CODES, RULES, PERMITS, FEES, AND STANDARDS

- A. All work described in this specification shall be done in accordance with any applicable Federal, State and Local Codes, Laws, Ordinances, Rules and Regulations governing work of this type.
- B. The Contractor shall give all necessary notices, obtain all permits and pay all governmental taxes, fees, deposits and other costs in connection with his work. He shall file all necessary plans, prepare all documents and obtain all required Certificates of Inspection and Approval for his work, including those for occupancy, and deliver same to The Design Professional before request for acceptance and final payment for the work.
- C. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus, drawings, in addition to Contract Drawings and Documents in order to comply with all applicable Codes, Laws, Ordinances, Rules and Regulations, whether or not shown on Drawings and/or Specifications.
- D. Nothing stated or shown in the Contract Specifications and Drawings is intended to conflict with the above regulations. Should the Contractor find any apparent conflict, it shall be his responsibility to notify the Architect before any work in question is performed or materials purchased.
- E. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of The Design Professionals, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work.
- F. All materials furnished and all work installed shall comply with the following rules, codes, and standards:
 - 1. 2019 Unified Facilities Criteria UFC 1-200-01 General Building Requirements - Except as indicated, use State of New York Adopted 2018 IBC and 2018 IEBC
 - 2. 2018 IBC Chapter 27-Electrical - Except as Modified by UFC 3-520-01 Interior Electrical Systems
 - 3. 2018 IBC Chapter 27-Electrical - Except as Modified by UFC 3-530-01 Lighting Controls
 - 4. 2018 IBC Chapter 27-Electrical - Except as Modified by UFC 3-550-01 Exterior Power Distribution
 - 5. 2018 IBC Chapter 27-Electrical - Except as Modified by UFC 3-580-01 Telecommunications

6. 2019 IBC Chapter 27-Electrical - Except as Modified by UFC 3-600-01 Fire Protection - 2019 UFC 3-600-1 Supersedes NFPA, Except Where Not Specifically Addressed by UFC - References to UFC shall be replaced with 2018 NFPA 1, Except where Superseded by UFC
 7. 2003 UFC 3-450-01 Noise and Vibration Control
 8. 2018 IBC Chapter 28-Mechanical - Except as Modified by UFC 3-410-01 HVAC Systems - UFC 3-410-2 Direct Digital Controls for HVAC
 9. 2016 NFPA 13-Standard for The Installation of Sprinkler Systems - 2019 UFC 3-600-1 Supersedes NFPA, Except where not Specifically Addressed by UFC
 10. IBC Chapter 29-Plumbing - Except as Modified by UFC 3-420-01 Plumbing Systems - 2014 New York City Plumbing Code - Chapter 10 - Traps, Interceptors, and Separators
 11. 2018 NFPA 1-Fire Code - Except Where Superseded by UFC 3-600-01 Fire Protection
 12. 2018 NFPA 54 (ANSI Z223.1) - National Fuel Gas Code
 13. 2017 NFPA 70-National Electrical Code
 14. 2018 NFPA 101-Life Safety Code - Except Where Superseded by UFC 3-600-01 Fire Protection
 15. 2016 NFPA 72-Fire Alarm Code - Except as Modified by UFC 3-600-01 Fire Protection
 16. 2013 ASHRAE 90.1-Energy Efficiency - Except as Modified by UFC 1-200-02 High Performance Buildings
 17. 2020 US Army Garrison, West Point, NY Engineering Planning Standards - Latest Edition
- G. Recommendations of the Fire Insurance Rating Organization having jurisdiction.
- H. Requirements of all government departments and agencies having jurisdiction.
- I. All package equipment shall be independently third party labeled as a system for its intended use by a nationally recognized testing laboratory in accordance with OSHA 29CFR 1910, NEC, and NFPA.

1.6 ABBREVIATIONS

- A. The following is a description of the abbreviations used herein:

AC	Alternating Current
ACRMA	Air conditioning & Refrigerating Machinery Assoc., Inc.
AIEE	American Institute of Electrical Engineers
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating & Air Conditioning Engineers
ASA	American Standards Association
ASTM	American Society of Testing Materials
AWG	American Wire Gauge Size
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association

NFC	National Fire Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Association
U.L.	Underwriters' Laboratories, Inc.
IBC	International Building Code
IMC	International Mechanical Code
IFC	International Fire Code

- B. Refer to the drawings for other symbols and abbreviations.

1.7 WORKMANSHIP

- A. All work under this Contract shall be properly coordinated with the work of all trades and separate Contractors with which it comes in contact.
- B. All work under this Contract shall be installed in a first-class, neat and workmanlike manner satisfactory to The Design Professional by experienced and skilled mechanics of the trade involved.

1.8 OPERATING INSTRUCTIONS

- A. Provide to the Owner three bound copies of complete written instruction on the operation, care and maintenance of each piece of equipment and the installation as a whole. Include frequency of inspection, cleaning and adjusting and other attention as may be required in accordance with manufacturer's instructions. Material shall be manufacturer's brochures, catalog cuts, parts lists, wiring diagrams, etc. Also supply Owner's with three complete sets of approved shop drawings.
- B. Furnish qualified personnel to instruct the Owner's personnel in the maintenance and operation of all equipment and systems. Instructing personnel shall remain on the job continuously during working hours until such instruction is complete, but not less than 40 hours.
- C. A video recording in digital format (DVD) of the operator training session shall be made during this training period and the DVD submitted to the Owner with the operation and maintenance manuals.

1.9 CORRECTION OF WORK AFTER FINAL PAYMENT AND GUARANTEE

- A. Final payment shall not relieve the Contractor of responsibility for faulty equipment, materials and workmanship and unless otherwise specified he shall remedy any defects due thereto and pay for damage to other work resulting therefore, which shall appear within a period of one (1) year from the date of acceptance.
- B. Include guarantees by the respective equipment manufacturers which shall be subject to the terms and time limits defined under this section.
- C. Guarantees furnished by Subcontractor and/or equipment manufacturers shall be counter-signed by the related Prime Contractor for joint and/or individual responsibility for subject item.

- D. Manufacturer's equipment guarantees or warranties extending beyond the guarantee period described herein shall be transferred to the Owner along with the Contractor's guarantees.

1.10 SUPERINTENDENCE

- A. The Contractor shall give his personal superintendence to the work or shall have a competent superintendent, satisfactory to The Design Professional, and the Owner, present at all times during construction with authority to act for him. The Contractor shall also provide an adequate staff for the proper installation, coordination and expediting of his work.

1.11 SCAFFOLDING, RIGGING, HOISTING

- A. The Contractor shall furnish all scaffolding, staging, rigging, hoisting and services necessary for erection and delivery into the premises of any equipment and apparatus furnished or installed by him and shall remove same from premises when no longer required.
- B. Scaffolding and staging construction and maintenance shall be in strict accordance with all applicable codes and regulations including Contractor's safety regulations. The structure shall be erected so as not to interfere with the work of others. If it becomes necessary to move the scaffolding and/or staging to permit installation of other work, the Contractor shall do so at his own expense.
- C. Scaffolding, staging and hoisting equipment shall not be supported from piping, conduits or other equipment.

1.12 ROOF PROTECTION

- A. Provide adequate roof protection during the construction phase and remove same after the work is completed. Any damage to the roof surface will be repaired at the expense of the Contractor.

1.13 SUPPORT STEEL AND MISCELLANEOUS WORK

- A. The Contractor shall provide all necessary miscellaneous steel required for the installation and support of the work under this contract. Work shall include but not be limited to conduit supports, equipment supports, gratings, handrails, transformers, etc. Perform all rigging required to set the equipment in place.
- B. Unless otherwise indicated, all structural steel shall be ASTM-A36 with hot dipped galvanized finish. Welds shall be finished with (2) coats of zinc rich paint.

1.14 AS-BUILT DRAWINGS

- A. The Contractor shall keep on the job a separate set of drawings on which he shall make a record of any changes in location, size or other details or installation not covered by supplemental or detail drawings. Such records shall be made at the time the changes in the work are made so that at any time the marked drawings indicate the true condition of the work. He shall record the exact dimensioned locations, grades, elevations and sizes of all underground and under floor slab conduit and piping. Dimensions shall be distance from columns, finished building surfaces, curbs and finished grade lines.

- B. All as-builts shall be archived in the Geographic Information System (GIS).
- C. Contractor shall provide electronic copies of all as-builts in source file format (*.dwg, *.rvt, *.nwf, etc.) and *.pdf format.
- D. At the completion of the work the marked drawings shall be transferred to AutoCAD 2005 (or later) drawings and the drawing files shall be forwarded to The Design Professional. All files shall be bookmarked by trade/system.
- E. Contractor shall provide (2) paper copies and (2) electronic copies.

1.15 PAINTING

- A. Generally, all painting shall be performed by this Contractor unless otherwise indicated.
- B. The Electrical Contractor shall be responsible for painting all color-coded junction boxes.

1.16 GUARANTEE

- A. All equipment and components of all systems furnished under this Contract shall be guaranteed to perform trouble free for a period of one year from the date of final acceptance of installation by The Design Professional. Any equipment that has been in operation prior to the date of acceptance shall also be guaranteed to be free of defects and perform without failures for a period of one year after the date of final acceptance. Any corrections and adjustments to the systems, replacement of equipment or parts during the guarantee period shall be furnished by the Contractor, at no additional cost to Owner.
- B. During the one (1) year guaranty period the Contractor shall make a minimum of two (2) visits to the site (6 months after acceptance and immediately prior to the end of the guarantee period). During each visit, the Contractor shall thoroughly check all equipment for proper operation. Reports shall be generated and forwarded to the Owner describing the systems inspected, date of inspection, and status of equipment.

1.17 SCHEDULING OF WORK

- A. The scheduling of any work affecting existing installations or facilities, shall be coordinated with the Owners' representative. Shut-down of utilities or equipment affecting operations of any existing part of the building will not be permitted except as provided below. Any premium time or additional cost to comply shall be at the expense of the Contractor and considered to be included in his bid. Shut-down of any operating facility or services including plumbing, fire protection, refrigeration, heating, air conditioning, electrical, or other installations shall be preceded by a written request at least seven calendar days prior to the shut-down.
- B. All required shut-downs unless otherwise instructed, shall be during nights, holidays, or on weekends. Any tests which are to be carried out on the building facilities and any connections to be made in the building facility which would involve a change in the system or liability to the system or involve a shut-down in light or power, the Contractor shall not proceed with such operations until he has received written permission from the Owner.

- C. Other Contractors will be performing work in the complex simultaneously while this Contractor is engaged to do work. The Contractor, in addition to coordinating with the Owner, shall coordinate and schedule shutdown of utilities, fire alarm, or equipment with the other Contractors. Should the failure of this Contractor to coordinate or notify the other Contractors of the shutdown of utilities cause a monetary burden on the other Contractors, this Contractor shall compensate the other Contractor's for their reasonable monetary loss.
- D. The facility will be occupied during construction. Alterations and connections to existing facilities shall be completed with a minimum of interruption to the existing operations. Where interruption is necessary, prepare a time schedule and scope of work outline for same, coordinate with Owner, and obtain prior written clearance.

1.18 CONCURRENT WORK BY THE OWNER

- A. The Owner reserves the right to have other Contractors perform work in other areas of the Complex simultaneously while this Contractor is engaged to do work. This Contractor and his personnel shall cooperate and coordinate the work to be performed with all other Contractors with who he comes in contact. In no way shall this Contractor interfere with the progress of the work.

1.19 CONSTRUCTION ELECTRICITY

- A. Electrical power for lighting and operation of construction power tools by all trades shall be provided by Contractor from local utility or Contractor's on-site generator. Contractor shall provide all safety devices, extension cords, and remote outlets as required by regulations and use. All construction electric power shall be GFCI protected.
- B. Contractor shall provide temporary generator to power the building while the electric service is being upgraded.
- C. Temporary lighting and wiring shall be provided by the Contractor as required by OSHA and be removed upon finishing the work.
- D. Coordinate with City Light and Power for permanent and temporary electric services.
- E. All temporary services connected to campus systems shall be metered.

PART 2 MATERIALS AND EQUIPMENT

2.1 GENERAL

- A. All installed materials and equipment shall be new and the best of their kind and shall conform to the grade, quality and standards specified herein in every detail.
- B. Unless otherwise specifically stated, all materials and equipment offered under these specifications shall be limited to products regularly produced and recommended by the manufacturer for the service intended. This material and equipment shall have capacities and ratings sufficient to amply meet the requirements of the project. The capacities and ratings shall be in accord with the Design Professional's

data or other comprehensive literature made available to the public by the manufacturer and in effect at the time of opening bids.

- C. Equipment shall be installed in accordance with manufacturer's instructions for type and quality of each piece of equipment used. These instructions shall be obtained from the manufacturer and shall be considered part of these specifications. Type, capacity and application of equipment shall be guaranteed suitable to operate satisfactory. No experimental material or equipment shall be permitted.
- D. All equipment, material and devices for which a label service is available shall bear the label of the Underwriters Laboratory, Inc. (UL).

2.2 CHASES AND OPENINGS

- A. Provide information to the appropriate trades regarding size and location of all openings and chases as required for the installation of this electrical Work.

2.3 CUTTING AND PATCHING

- A. Provide all cutting and patching required for work performed under this Contract. No holes may be cut or drilled in structural members without prior approval of Owner's Representative. Cutting shall be done by mechanics skilled in their respective trades.
- B. No cutting that may impair the strength of the building construction shall be done. No holes may be drilled in or attachments welded to the beams or other structural members without prior approval from the Owner's Representative. All work shall be done by mechanics skilled in their trade.
- C. All patching shall be done in a manner to match appearances and quality of existing surfaces.
- D. Provide sleeves for conduits, raceways, and cables passing through poured concrete decks, footings, walls, etc. Cut all openings for conduit passing through precast concrete or existing concrete masonry. Such holes shall be cut with core drill or similar equipment. They shall not be cut with hammer or chisel, or with any power tool depending on impact for its cutting power.
- E. For holes and openings in pre-cast concrete, 2-1/2 inch round and above, or 2-1/2 inch and above on longest side, prepare a drawing for the Design Professional's review for same to be pre-cast in the factory; for holes and openings smaller than above, prepare a drawing for the Design Professional's review for same to be cut, cored or drilled in the electrical trade.
- F. All cutting and patching shall be performed by the Contractor. All holes shall be core bored. All floors, blacktop, walks, curbs, etc. shall be saw cut.
- G. The Contractor shall prepare required openings for ductwork, piping, conduit, and all other work required for the installation of the equipment and systems installed.
- H. Unless otherwise indicated, the Contractor shall patch and seal all walls, floors, ceilings (drywall, plaster, lay-in, etc.) soffits, etc. where existing items such as conduit, raceways, hangers, supports, etc. Are removed or new work is installed under this contract. All patching shall be performed with equivalent materials and finishes and shall match adjoining surfaces in both texture and finish.

- I. Remove and replace existing ceiling system tiles and grids as required to install the new work. Repair as necessary and use new grids and tiles to match the existing.
- J. The contractor shall properly set all sleeves required for his work described under this section during construction.
- K. Where sleeves and openings are not installed or are incorrectly sized or located as a result of Contractor's failure to furnish verifying drawings or set sleeves in sufficient time so as not to delay construction, all cutting and patching shall be done by the respective Contractor in a manner of satisfactory to the Design Professional and all costs are borne by the Contractor.
- L. Conceal conduit in all finished locations. Cut and patch existing ceilings, walls, and structural members where necessary for concealment.

2.4 DEVICE BOXES

- A. Provide for each device indicated, a box suited to the purpose for which the device is to be put and to the location in which it occurs.
- B. Concealed device boxes shall be pressed steel, not less than 4" square, and 1½" deep, zinc-coated and provided with the proper size knockouts for the conduits to be used. All unused knockouts shall remain closed. Boxes in concrete slabs shall not be less than 2" deep. Boxes in finished plaster surfaces shall be provided with suitable approved plaster covers. Cast boxes with threaded hubs shall be used for all surface mounted switches, receptacles, etc. Use minimum 2½" deep masonry box for 4" block and minimum 3½" deep masonry box for 6" and 8" block.
- C. Do not install device boxes back-to-back.
- D. Coordinate with Design Professional prior to installation for all device mounting heights.
- E. Secure electrical devices firmly in place within boxes, setting devices straight and true with box sides and mounting surface.
- F. Install face plate straight and true with mounting surface.
 - Gaps between back of plate and mounting surface are not permitted.
 - Set face plate mounting screws with slots in vertical direction.
- G. All backboxes recessed in concrete or CMU masonry walls shall sit flush with face of wall. Provide boxes with proper depth and/or extension ring.
- H. Wiring devices to be furnished and installed by this Contractor shall consist of the various types of wall switches, receptacles, outlets, and plates as required for the Electrical Work. The extent of the wiring devices shall be shown on the drawings.
- I. Local wall switches near doors shall be located on the strike side of doors as finally hung, whether or not so indicated on the Plans. If, because of the construction, it is not practical to mount on the strike side,

these locations shall be brought to the Design Professional's attention, and meet his approval before roughing in.

- J. Single pole switches shall switch the ungrounded wire of circuits. Neutral wire shall not run through switches provided with a neutral shunt or bridge.
- K. Switches shall be mounted with the long dimensions vertical.
- L. For each voice, data, voice/data, CATV, and audio outlet shown, provide a 4" square by 2-1/8" deep box with conduit and pull wire turned out above an accessible ceiling space unless otherwise noted.
- M. All receptacles and communication outlets located next to each other shall be mounted 8" apart (horizontally) center to center.
- N. All communication outlets located adjacent to each other shall be ganged under single cover plate.
- O. All switches located adjacent to each other shall be ganged under single multi-gang cover plate.

2.5 JUNCTION AND PULLBOXES

- A. Provide junction and pullboxes in conduit and EMT runs as shown or as required. These shall be of code gauge galvanized steel, riveted or welded construction, reinforced as necessary for rigidity during and after installation, and with proper flanges to receive the covers, unless otherwise indicated.
- B. Boxes shall be not less than sizes required by Article 314 of National Electrical Code or as shown on Drawings, and large enough to accommodate wiring without sharp bends in conductors or excessive bearing of wires against covers.
- C. In vertical runs of conduit provide a NEC sized junction box with cable support bushing and insulating wedges spaced not greater than the values given in NFPA 70 Table 300-19 (a) unless otherwise noted. If wedges do not adequately support cable, in addition, provide cable clamps.
- D. Rigid conduit connections shall be secured in place by double locknuts and insulated bushings.

2.6 HANGERS AND SUPPORTS

- A. Reference Section 260529 for additional requirements.
- B. Runs of exposed conduit and EMT shall be supported from approved individual pipe hangers spaced in accordance with the National Electric Code. Hangers shall be approved as electrical raceway support devices. Caddy fasteners will not be accepted.
- C. Hanger rods shall be supported from approved malleable iron inserts, imbedded in the concrete floor slabs at the time the floor slabs are poured, approved anchor at attachment C-type malleable iron clamps, or from unistrut support system.
- D. All materials and equipment installed by the CONTRACTOR shall be firmly supported and secured by the construction. Where necessary, anchors shall be non-hydrophobic and shall be inserted in holes drilled in the construction in accordance with the manufacturer's instructions.

- E. Raceways, boxes, etc. shall be supported directly from structure, independent of ceiling grid system, duct, piping or other work. Provide unistrut framing, as required, to clear interferences from the other trades,
- F. Conduits and EMT shall be securely and independently supported so that strain will not be transmitted to outlet box and pullbox supports, etc. Supports shall be rigid enough to prevent distortion of conduits during wire pulling.
- G. Provide all structural support steel for the installation of the new TV and Projector mounts.

2.7 WIRING DEVICES

A. Wall Switches

- 1. Switches for the local control of lighting shall be of the extra heavy duty specification grade, quiet toggle type.

B. Receptacles

- 1. Receptacles for convenience outlets shall be extra heavy duty specification grade grounding duplex, parallel slot, self-aligning type.
- 2. All NEMA 5-20R receptacles shall be GFCI type where located in the laboratory space. Devices that are not readily accessible shall be fed from GFCI circuit breakers.
- 3. All exterior receptacles shall be GFCI type.
- 4. All receptacles shall be tamper-proof.

C. Special Purpose Outlets

- 1. Where shown on the drawings, provide special purpose extra heavy duty specification grade outlets of the ampere capacity, voltage, and NEMA configuration indicated.

D. Wall Plates

- 1. Unless otherwise specified, all wall plates for switch, receptacle, and similar outlets shall be brushed stainless steel with beveled edges to lie flat against the wall. Where more than one switch or outlet occurs at one point, gang plates shall be used.
- 2. Weatherproof receptacles shall have horizontal metal weather protective covers equal to Mulberry #30451Z (bronze). Provide weatherproof "While-In-Use" covers where indicated and for all sump sumps.
- 3. Weatherproof switches shall have cast metal lever type cover plates.

- E. All devices shall be recessed, unless otherwise noted. Contractor shall cut and patch existing structure to recess all devices, conduit, and wiring in finished areas.

2.8 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Adhesive Marking Labels for Raceway and Metal-clad Cable: Pre-printed, flexible, self-adhesive labels with legend indicating voltage and service (Emergency, Lighting, Power, Light, Power D.C., Air Conditioning, Communications, Control, Fire).
 - 1. Label Size: As follows:
 - a. Raceways 1-inch and smaller: 1-1/8 inches high by 4 inches long.
 - b. Raceways larger than 1-inch: 1-1/8 inches by 8 inches long.
 - 2. Color: Black legend on orange background.
- B. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- C. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with Eyelet for fastener.
- D. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.
- E. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.
- F. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gauge, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.
- G. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.
- H. Pressure sensitive industrial tape with adhesive backing and Helvetica lettering. The lettering shall be applied with a Kroy high performance labeling machine or equal. Tape shall be clear with black lettering.

2.9 SUBSTITUTIONS

- A. Light fixture substitutions will not be accepted. Provide specified items.
- B. Equipment may be shown or specified in several ways:
 - 1. Manufacturer and catalogue or model number with the words "no substitutions," "no equal," "(manufacturer) only," or words of similar respect. Contractor shall furnish the specified item.
 - 2. Several manufacturers and model numbers listed; or one manufacturer and model number, followed by "equals by (mfr A), (mfr B), (mfr C)," or words of similar respect.
 - a. If one of the manufacturers is listed on the drawings, that manufacturer shall be considered the basis of design. If none is so listed, the first manufacturer named in the Specification shall be considered the basis of design.

- b. Where manufacturer's or supplier's name, style and catalog numbers are mentioned in the description of material and equipment in the specifications or on the drawings, it is to be understood that they are for the purpose of setting a standard.
 - c. If Contractor elects to furnish equipment other than the basis of design, he shall verify capacities, physical size, weight, HVAC requirements, methods of connection to other parts of the system, and all other relevant data. Contractor shall be responsible for informing the Design Professional of all changes required to other equipment, spaces, structure or systems in order to install the substituted equipment. He shall furnish all required shop drawings or sketches required for Design Professional to evaluate the required changes, and shall be responsible for all costs associated with such changes, including costs of design or engineering, if such are necessary, and costs of other trades.
- 3. Where manufacturer's or supplier's names are listed in conjunction with the manufacturer or supplier that is basis of design, they are given to approve the firm name only. Equipment or material submitted by such firms must meet the detailed technical specifications written for the respective item. Contractor shall be responsible for verifying capacities, physical sizes, weights, HVAC requirements, and methods of connection to other parts of the system, etc. Contractor shall furnish all required shop drawings for equipment, and for its connection and installation.
- C. If any substituted items are submitted after contracts have been awarded, and there is any question of equality of such items, samples may be required to be submitted both for the item specified and that to be substituted, or, further proof of equality may be required to the entire satisfaction of the Design Professional. In no case shall additional remuneration be allowed because of the rejection of a substitute.
- D. When the equipment is relocated to a place other than that shown on the drawings, or when equipment other than that specified is used, the Contractor shall pay the extra cost of required revisions such as structural steel, concrete, HVAC, piping, etc.
- E. The Design Professional's costs to evaluate substitutions and to revise Drawings and Specifications because of substitutions will be paid by the Contractor.

2.10 SHOP DRAWINGS

- A. Furnish shop drawings, catalog cuts, performance data and other required data to the Design Professional for review for all material and equipment specified hereinafter. Sufficient data shall be submitted to show compliance with the requirements of the plans and specifications. All shop drawings submitted shall be first checked and corrected before submitting for approval. Approval for shop drawings by the Design Professional will not relieve the Contractor from responsibility for errors or omissions therein. All such errors or omissions must be made good by the Contractor irrespective of any approval by the Design Professional.
- B. On submissions beyond the initial one, clearly identify changes made from the initial submittal other than those requested by the Design Professional. The Design Professional will review only those changes he requested and those identified by the Contractor.
- C. Shop drawings required shall include, but not necessarily be limited to, the following:
 - 1. Shop drawings, cuts and catalogue information showing appearance, dimensions, performance, weight, etc., of all equipment, appurtenances, etc.

2. Schedules of all materials showing type and manufacturer.
 3. Wiring diagrams and schematics for equipment.
 4. All special equipment and systems.
 5. Any special constructions.
 6. Other shop drawings as may be requested.
- D. Digital files of Electrical work will not be provided for the purpose of shop drawing preparation. Digital files of architectural plans, elevations, sections, etc. may be available for background purposes; it is the responsibility of the Contractor to confirm availability prior to bid.
- E. Facsimile submission of shop drawings will not be accepted as the submittal format. An advanced copy for starting the process may be faxed but hard copy submittals are to be submitted for actual review.
- F. Electronic submission of shop drawings shall be permitted in the format as noted elsewhere in the specifications.
- G. Shop drawings shall be submitted in a timely manner, taking due account of time requirements for processing, correcting and distributing the shop drawings to all persons or trades requiring the information, as well as time required for manufacture of the equipment. Design Professional will not be responsible for construction delays resulting from late submission of shop drawings, nor for delays caused by the need to correct and resubmit shop drawings which were not correct, which involved substituted equipment, or otherwise required review, correction and resubmission.
- H. If Contractor elects to proceed to install equipment for which approved Shop Drawings have not been received, he does so at his own risk; Design Professional is not obligated to accept such equipment or work, nor will Design Professional be liable for claimed costs or delays required by correction of such work.

PART 3 EXECUTION

3.1 VISIT THE SITE

- A. Before submitting bid, visit the site of the work and be thoroughly familiarized with the conditions affecting the work. No extra payment will be allowed on account of extra work made necessary by failure to do so.

3.2 WORKMANSHIP

- A. All work shall be installed in a first class, neat and workmanlike manner by mechanics skilled in the trade involved. All details of the installation shall be mechanically correct. Should the Design Professional direct removal, change, or installation of any equipment's or systems not installed in a neat and workmanlike manner, such changes shall be made by the Electrical Contractor at no expense to the Owner.

- B. Equipment shall be installed in strict accordance with manufacturer's instructions for type and capacity of each piece of equipment used. The Contractor shall obtain these instructions from the manufacturer and these instructions shall be considered part of these specifications. Type, capacity, and all applications shall be suitable and shall operate satisfactorily for the purpose intended for the system.
- C. Drawings are generally indicative of the work to be installed, but do not indicate all bends, offsets, fittings, junction / pull boxes, hand holes and specialties which may be required, or the exact locations of all conduit. Contractor shall investigate structure and finish conditions affecting his work and arrange his work accordingly; furnishing such items as may be required to meet such conditions. Contractor is responsible for exercising proper judgment to arrange his work and materials so as to avoid interference with other trades.
 - 1. Riser diagrams and schematics generally indicate equipment to be used in various systems involved. This information may or may not be duplicated on the plans, but equipment shown on either plans or riser diagrams and schematics shall be provided as if shown on both.
 - 2. All grades, elevations, dimensions and clearances of equipment shown on drawings are approximate and shall be verified at site.
 - 3. Where work or equipment is referred to in singular terms, such reference shall be deemed to apply to as many items of work or equipment as required to complete entire installation.
- D. All materials and equipment shall be new and shall conform to the grade, quality, and standards specified herein in every detail.
- E. All materials and equipment shall be made in the USA.
- F. All equipment offered under these specifications shall be limited to products regularly produced and recommended for the specified service. Ratings shall be in accordance with the Design Professional's data or other comprehensive literature made available to the public and in effect at this time.

3.3 LINES AND GRADES

- A. Layout work and establish heights and grades for work in strict accordance with the intent expressed by the drawings and all the physical conditions at the building and be responsible for the accuracy of same.

3.4 FIELD MEASUREMENTS

- A. Before ordering any material or doing any work, verify all measurements at the building and site and be responsible for the correctness of same. No extra compensation will be allowed on account of differences between actual dimensions and measurements and those indicated on the drawings. Any difference which may be found shall be submitted to the Design Professional for consideration before proceeding any further with the work.

3.5 DELIVERY OF EQUIPMENT

- A. Be responsible for delivery of equipment, unload and store in a manner not to interfere with the operation of other trades. Additional expense incurred because of equipment or material delivery delays shall be assumed by the responsible Contractor.

3.6 PROTECTION OF WORK

- A. All work, equipment and materials shall be protected at all times.
- B. All raceway openings shall be closed with caps or plugs during installation. All equipment shall be tightly covered and protected against dirt, water, plaster, paint and other foreign material or mechanical injury during entire progress of installation. Make good all damage caused either directly or indirectly by workmen employed to fulfill requirements of the Electrical Work.

3.7 REMOVAL OF RUBBISH

- A. During the course of construction, periodically remove from the premises all rubbish resulting from work of this trade so as to prevent its accumulation. At the completion of the work contemplated under these Specifications remove from the building and site all rubbish and accumulated materials of whatever nature not caused by the other trades and leave work, and equipment free of all foreign matter including plaster, cement, and paint and leave in a clean, orderly, acceptable and usable condition.

3.8 COORDINATION WITH OTHER TRADES

- A. Work in conjunction with each of the other trades to facilitate proper and intelligent execution of work with minimum interference.
- B. If contractor installs work so as to cause interference with work of other trades, he shall make necessary changes in work to correct the condition without extra charge.
- C. Dimensional layout plans of equipment rooms shall be made showing all bases, pads and inertia blocks required for electrical equipment. Include dimensions of bases, bolt layouts, details, etc.
- D. Contractor shall furnish all necessary templates, patterns, etc. for installing work and for purpose of making adjoining work conform, furnish setting plans and shop details to other trades as required.

3.9 ANCHORS AND GUIDES

- A. Anchors shall be provided where shown and/or required for the proper control of stress in conduit due to expansion.

3.10 ACCESS

- A. All equipment requiring maintenance or adjustment must be accessible. Items located above ceilings shall be located above accessible portions of the ceiling or above access panels provided by this Contractor. Manufactured items with internal components requiring access (whether integral with the enclosure or not) shall be provided with access panels. Access panels shall be provided in ductwork where required for maintenance or adjustment of internal components.
- B. Provide access panels in walls and ceilings to give access to all control equipment, junction/pull boxes, and other similar electrical devices which could otherwise be accessible.

- C. Access panels shall have not less than No. 16 U.S.S. gauge steel frame, not less than No. 14 U.S.S. gauge steel door, not less than 1/8" neoprene secured to the inside of the door and standard screw driver lock.
- D. In unplastered masonry block walls, the height of the panels shall be a multiple of the height of the block courses. All access panels shall not be smaller than 12 inches wide by 18 inches unless otherwise indicated or directed, and shall be installed flush with the finished wall or ceiling and shall be painted with not less than two coats of paint to match adjacent walls.
- E. In fire rated assemblies the access panels shall be fire rated.

3.11 FIRESTOPPING

- A. All penetrations through fire-resistance-rated floor, fire resistance rated, floor/ceiling assemblies and roof construction and through fire-resistance-rated walls and partitions shall be fire stopped.
- B. Penetrations to be fire stopped include both empty openings and those containing cables, pipes, ducts, conduits and any other items.
- C. Fire rating of sealed penetrations shall meet or exceed the rating of the assembly being penetrated.
- D. Materials shall be installed in accordance with manufacturer's recommendations and their UL listing.

3.12 CONDUIT AND EMT GENERALLY

- A. Unless otherwise indicated or specified, all new conduit and EMT devices and controls shall be concealed in walls and ceilings, and wiring devices and controls shall be flush mounted, except in Equipment Rooms.
- B. All conduit and EMT shall be installed as closely as possible to walls, columns and structural members so as to occupy a minimum of space. Conduit and EMT shall be run plumb and square with the building lines.
- C. All conduits, EMT, fittings and supports shall be installed so as to preserve access to all outlet, junction and pull boxes, and fixtures.
- D. All conduit, EMT and other work required by these specifications and by the applicable drawings will be laid out and installed with the complete work of all trades in mind. The Contractor is cautioned that close coordination between trades will be required for the successful completion of this work, and in case interference with the work of other trades should develop, the Design Professional shall determine which work is to be relocated, regardless of which was first installed at no additional expense to the Owner.
- E. All conduit, EMT and wireways shall be kept a sufficient distance from other work to permit a clearance of not less than one (1) inch between raceway and the finished covering of ducts, cold water piping, valves and fittings and all adjacent work. Maintain a minimum of three (3) inches from hot water and steam piping.
- F. The drawings are generally indicative of the work to be installed and do not indicate all offsets, bends, fittings, supports, boxes, access panels and similar parts which may be specified or required. Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange all his work

accordingly furnishing such fittings, bends, supports, boxes, access panels and other similar parts as may be required to meet such conditions.

- G. Conduits and EMT penetrating walls and floors shall be installed so that water proofing can be flashed into and around them. Sleeves through exterior walls below grade shall have the annular space between the conduit and/or EMT and sleeve caulked watertight. Sleeves in masonry walls shall be standard weight steel pipe.
- H. All exposed conduits in occupied areas must be provided with heavy, solid pattern, painted escutcheons where such materials pass through wall, floors, or ceilings. Escutcheons are not required in equipment rooms or unfinished areas.

3.13 WIRING METHODS

- A. All wiring systems shall be contained in raceways. All wiring devices and conduit shall be concealed. Generally, except where otherwise specified or indicated on drawings, wiring shall consist of insulated conductors in rigid zinc-coated steel conduit or EMT concealed within the building construction. Where ceiling system consist of exposed precast plank, wiring shall be run concealed inside plank, and run concealed within the walls. Where conduits must run through exposed joist, all horizontal conduit shall be run fastened along top joist member and conduit dropped down to each lighting fixture, backstop, etc. All conduit within new walls and through existing building shall be run concealed. Where branch circuits are to be contained in existing construction, and there is hollow spaces within the construction, a flexible conduit system (Greenfield) may be fished within the wall, otherwise cut and patch existing structure to conceal conduit.
- B. Wire and cable work shall consist of the various types of wires, cable, connectors, and fittings for complete wire and cable systems as required for the Electrical work. Note that raceways shall be provided for all wiring systems including lighting power, control, paging, intercom, fire alarm, and telephone.
- C. Wire and cable shall not be drawn into conduit and raceways until conduit is cleaned. The inside of conduit and raceway shall be dry and clean before wires are pulled.
- D. Care shall be exercised in pulling to avoid damage to the wire or cable. Lubricants shall not be used for pulling wire or cable, if the character of the lubricant would otherwise damage the conductors, insulation or jacket. Lubricants used shall be approved by the Design Professional.
- E. Wire and cable for feeders, sub-feeders, control and branch circuit wiring shall be color coded. Color coding scheme shall be maintained throughout the project. Submit scheme to Design Professional prior to installation.
- F. The switch legs for local wall switches shall have distinctive color coding scheme.
- G. Feeder cables shall be tagged in all pull boxes, wireways, and wiring gutters of panels. Tags shall identify wire or cable number and/or piece of equipment served. Tags shall be of non-combustible materials.

3.14 GENERAL PROVISIONS FOR WIRE AND CABLE WORK

- A. Branch lighting and receptacle circuits are two wire circuits with individual neutral conductors. Note that branch circuit numbers indicated on drawings are for clarification of circuits only and do not necessarily indicate final connections to panelboard. Branch circuits shall be arranged to balance the loads across the phases of the panelboard feeders. Contractor shall, under final operating conditions, rearrange (rotate) new and existing branch circuits so that a minimum current will flow in each feeder's neutral cable, with all panelboard branch circuits in use.
- B. Contractor shall provide additional conductors as required for 3 way, 4 way switching, separate ballast switching, emergency battery packs, if indicated on drawings, wiring for night lighting if fixtures are so designated, etc.
- C. All wiring in cabinets, panelboards, pull boxes, and junction boxes shall be neatly tied and held with Ty-Rap nylon ties.

3.15 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Install electrical connections as indicated; in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Coordinate with other work, including wires/ cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Maintain electrical service and feeders to occupied areas and operational facilities. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate or abandon existing wiring as noted. At no time shall the life safety or fire alarm systems to the building be without power.
- E. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
- F. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- G. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by

utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

- I. Provide flexible metallic conduit for transformers, motor connections, lighting fixtures, and other electrical equipment connections, where subject to movement and vibration.
- J. Provide liquid-tight flexible metallic conduit for connection of motors and other electrical equipment where subject to movement and vibration, and also where connections are subjected to one or more of the following conditions:
 - 1. Exterior location;
 - 2. Moist or humid atmosphere where condensate can be expected to accumulate;
 - 3. Corrosive atmosphere;
 - 4. Water spray;
 - 5. Dripping oil, grease or water;
 - 6. Inside air handling units;
 - 7. To all pump motors.
- K. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number.
- L. Maximum length of all types of flexible conduit shall be 72".

3.16 MANNER OF INSTALLATION

- A. All work shall be installed in a first class, neat and workmanlike manner by mechanics skilled in the trade involved. All details of the installation shall be mechanically and electrically correct.
- B. The drawings are generally indicative of the work to be installed but do not indicate all bends, fittings, boxes and specialties which may be required or the exact locations affecting all the work. The CONTRACTOR shall arrange the work accordingly, and furnish such fittings and junction boxes as may be required to meet such conditions at no additional cost to the OWNER, and arrange all runs of conduit to clear beams and other obstructions.
- C. Removable panels required for access shall be provided by the CONTRACTOR.

3.17 INSTALLATION OF PULL AND JUNCTION BOXES

- A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-inches square by 4-inches deep.
- B. Cable Supports: Install clamps, grids or devices to which cables may be secured. Arrange cables so they may be readily identified. Support conductors inside boxes.
- C. Mount pullboxes in inaccessible ceilings with the covers flush with the finished ceiling.

- D. Size: Provide pull and junction boxes for telephone, signal and other systems at least 50 percent larger than would be required by Article 314 or NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of types normal for such systems. A maximum of (2) 90° bends in conduit or EMT shall occur between junction boxes.

3.18 INSTALLATION OF IDENTIFICATION PRODUCTS

- A. Install identification devices in accordance with manufacturer's written instructions and requirements of the NEC.
 - 1. All electrical equipment shall be required to be labeled to comply with OSHA and ANSI/ASME A13.1-2015 standards for the identification of systems.
 - 2. The marking system shall identify the voltage of the contents.
 - 3. All equipment must be identified using phenolic nameplates and labeled in accordance with the nomenclature used on the drawings and compatible with the MIMS System.
- B. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- C. Identify Junction, Pull and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers which identify contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.
- D. Conductor Color Coding: Provide color coding for secondary service, feeder and branch circuit conductors throughout the project.
 - 1. Use conductors with color factory-applied the entire length of the conductors except as follows:
 - a. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.

xApply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal point and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
 - 2. Three-phase color coding, Phase A, B, and C order – 480/277 volt shall be brown, orange, yellow, and 208/120 volt shall be black, red, and blue.
- E. Power Circuit Identification: Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders and power circuits in vaults, pullboxes, junction boxes, manholes and switchboard rooms with 1/4 inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55 lb. test monofilament line or one-piece self-locking nylon cable ties.

- F. Tag or label conductors with vinyl film type wire markers as follows:
1. Multiple Circuits: Provide legend indicating source, voltage, circuit number and phase for branch circuit wiring. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
 2. Match identification markings with designations used in panelboards shop drawings, Contract Documents and similar previously established identification schemes for the facility's electrical installations.
- G. Apply warning, caution and instruction signs and stencils as follows:
1. Install warning, caution or instruction signs where required by NEC, where indicated or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
- H. Install equipment/system circuit/ device identification as follows:
1. Apply mechanically fastened equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems. Except as otherwise indicated, provide single line of text, with 1/2-inch high lettering on 1-1/2-inch high label (2-inch high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Mechanically apply labels for each unit of the following categories of electrical equipment:
 - a. Panelboards, electrical cabinets and enclosures
 - b. Access doors and panels for concealed electrical items
 - c. Motor starters and VFD's
 - d. Each feeder circuit breaker or fused switch
 - e. Disconnect switches
 - f. Switchgear sections
 - g. Transformers
 - h. Lighting control panels
 2. Apply circuit/control/items designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide frames, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
- I. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

3.19 LOCATION OF OUTLETS

- A. This Contractor shall examine all architectural drawings and details before locating outlets. Outlets shall be placed as required to harmonize with moldings, panels, etc. Outlet locations shall not be obtained from scale dimensions on electrical drawings but from measurements on architectural plans and/or details.
- B. If an outlet is installed by this Contractor in such a location as to be out of proper relation to beams, walls, or other details of the building, its location shall be corrected by, and at the expense of this Contractor, at the direction of the Design Professional.

3.20 COLOR CODING OF RACEWAYS AND BOXES

- A. Junction boxes shall be primed and painted with the following colors:

480/277V	Dark Blue
208/120V	Light Blue
Voice/Data/Communication	Yellow
Fire Alarm	Red
Medium Voltage	Red

- B. All medium voltage conduits, pull, and junction boxes shall be painted "red".

3.21 ELECTRICAL DRAWINGS

- A. The Contractor shall note that the Electrical Drawings are intended to indicate only the extent diagrammatically, general character, and locations of the work included. Work intended but having minor details obviously omitted or not shown shall be furnished and installed complete to perform the functions intended. For building details the Architectural and Structural Drawings, and Mechanical, Plumbing, and Fire Protection Drawings and Specifications shall be followed and the work of the Electrical Drawings and Specification shall be coordinated and fitted thereto.
- B. Riser diagrams are schematic and are provided to indicate the system in general to be installed. This information may or may not be duplicated on the plans; however, equipment shown on either the plans or riser diagrams and schematics shall be provided as if shown on both.
- C. In general, the number of wires in each branch circuit raceway has not been indicated, but shall be provided as required.
- D. Arrangements of conduit wiring and equipment that differ materially from the obvious intent of the drawing will not be permitted except where necessary to avoid interferences and then, or except when, specifically approved by the Design Professional.
- E. In case of conflict between that Specified and the Drawings, the proper interpretation shall be made by the Design Professional whose decision shall be binding.

3.22 ABANDONMENT, REMOVAL, AND RELOCATIONS

- A. All removed equipment and material not wanted by the Owner shall become the property of the Contractor and shall be removed immediately from the site.
- B. Any existing apparatus or device required to remain in operation, although not specifically shown or mentioned, shall be connected or reconnected and supplied from an available source of power.
- C. Remove all equipment, backboxes, branch circuit wiring and control wiring for devices and equipment that are not required in the new facilities.
- D. Any existing apparatus or device to be retained shall be disconnected and relocated and reinstalled as required to allow for new wall or ceiling finishes.
- E. Provide new typed panel schedules on each new and existing panelboard and switchboard describing each circuit.

3.23 ELECTRICAL EQUIPMENT LOCATIONS

- A. The plans accompanying this specification have been drawn to scale and indicate the general arrangement required, but small-scale plans are diagrammatic and the Electrical Contractor shall be guided by the mounting heights noted herein or on the drawings.
- B. All locations are subject to changes that will ease installation or may be necessary to avoid obstacles in building construction.
- C. The Electrical Contractor shall verify all dimensions and conditions at the site and check the layout for sizes and clearances to be sure that the apparatus and materials he proposed to furnish may be installed and operate satisfactorily in the space allotted to it. Equipment and wiring shall be installed in accessible locations.
- D. Before installing any work, the Electrical Contractor shall have obtained final locations of all outlets and equipment from the Mechanical, Plumbing, and Fire Protection Contractors, and he shall examine drawings for other trades and avoid interferences with their work. In cases of interference, priority of installation will not relieve the Electrical Contractor of his responsibility to avoid interferences.
- E. No changes are to be made in the original design without the written approval of The Design Professional.
- F. Unless otherwise located to comply with "Handicap Regulations" or indicated on Electrical or Mechanical drawings, mounting heights shall be as follows:

Wall Switches	40" above finished floor
Convenience Outlets	18" above finished floor unless otherwise indicated or located above countertops and 48" above finished floor in Mechanical Rooms
Starters, Disconnect Switches and Enclosed Circuit Breakers	5'-0" to center line from finished floor
Panelboards	6'-6" to top circuit breaker

Fire Alarm Horn/Strobes	80" above finished floor
Fire Alarm Pullstations	40" above finished floor
Voice/Data Outlets	18" above finished floor unless otherwise indicated
Video/Cable TV Outlets	Coordinate with Architect prior to rough-in

END OF SECTION 260500

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SECTION 260510 - WORK IN EXISTING BUILDING

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 WORK DESCRIPTION

- A. Note that construction is to be performed in existing facilities and that the Drawings generally show only new work that is required. The Drawings do not show in detail how the new work is to be installed because unknown obstructions to its installation may be disclosed as the work progresses. Perform the work indicated, and perform such additional work as may be required but is not specifically shown. Perform this work in such a manner as to overcome all obstructions and difficulties that are encountered. Perform such work in full cooperation with the Engineer who will help decide at the site how this work is to be done.
- B. All work in this section shall be provided by the Contractor at no additional cost to the Owner. Contractor shall, prior to bidding, visit the site and review the complete set of Construction Documents, including addendums, to verify the extent of equipment, devices, light fixtures, feeders, junction/pull boxes, and branch circuits that must be relocated and include this cost in the bid proposal.

1.3 PRODUCTS

- A. Use products that are compatible with existing materials. Wherever possible, use products of the same manufacturer as existing materials.

1.4 EXECUTION

- A. Check existing electrical installations and connect new work. Verify locations and capacities of existing facilities, prior to bidding, and rework these facilities as required to accommodate the new work. Make minor modifications to the work shown as required for compatibility.
- B. Remove and/or relocate existing equipment as required by the renovations and to accommodate the new mechanical and plumbing equipment, piping, and ductwork. Reconnect disturbed equipment and place in operating condition.
 - 1. Where new construction interferes with existing outlets, remove the outlets and replace them with new outlets in the new construction. Extend existing wiring as required.

2. Where new interior building surfaces are installed, extend existing outlet boxes out to new surface with appropriate extension rings.
 3. Where parts of the existing wiring system are disrupted, rework wiring as required to re-energize loads that are to remain in operation. Cut the structure on each side of outlets to be removed, remove existing conduit and wiring, provide new conduit and wiring between remaining outlets, make final connections, and patch structure.
 4. Where outlets are cut off from an existing feed, re-feed them from another direction if possible, and provide new conduit and wire if necessary.
- C. Remove and/or relocate existing feeder and branch circuit wiring and conduit as required by the renovations and to accommodate the new mechanical and plumbing equipment, piping, and ductwork. Reconnect disturbed facilities and place in operating condition.
1. Where new construction interferes with existing feeders and branch circuits, relocate, extend, and reconnect existing wiring as required. Where parts of the existing wiring system are disrupted, rework wiring as required to re-energize loads that are to remain in operation.
 2. Where existing feeders and branch circuits required to remain in service are concealed in existing walls and floors that are being demolished, Contractor shall relocate the existing feeders and branch circuits. Feeders and branch circuits shall be re-routed, reconnected, and placed in operating condition.
- D. Where existing ceilings are being removed and not being replaced with new, all existing metal clad (MC) cable branch circuits that must remain in service shall be replaced with new branch circuits installed in conduit.
- E. Remove circuits not required in the renovated area back to source of power including all hangers, supports, conduits, junction boxes, etc. All feeders, conduit, circuits, wiring, and cabling passing through renovated area which serves other areas of the building shall be retained. Relocate and reconnect as required for the new construction.
- F. Existing power, lighting, and low voltage circuits beyond contract limits shall remain in service. Recircuit and switch as required.
- G. Contractor shall bundle and support all existing voice/data, fire alarm, security, control, etc. cables required to remain in service and are located above ceilings and below the raised floors. At no time shall existing cables lay on the ceiling system or be routed haphazardly.
- H. Contractor shall bundle and support all existing metal clad (mc) cables required to remain in service and are located above ceilings or below the raised floors. At no time shall existing cables lay on the ceiling system or be routed haphazardly. Power and low voltage cables shall not be bundled together. Cable shall not be supported from the sprinkler piping or ceiling support system.
- I. All existing fire alarm devices to be replaced with new unless otherwise noted to remain or be relocated. Relocate and provide new as shown. Existing strobe candela rating shall be changed to compensate for the new locations. New device candela ratings shall be based on the new layout and room configuration/size.
- J. Where existing ceilings are being removed and not being replaced with new, all existing fire alarm cabling

not installed in conduit shall be replaced with UL Listed Fire Alarm cable installed in conduit. Cable shall be compatible with the existing fire alarm system.

- K. Remove all existing to remain device cover plates for application of new wall finishes. Provide new device plates as specified. Provide box extensions as required.
- L. Remove all backboxes and conduit where existing low voltage and telecommunications cabling is being removed. Backboxes recessed in masonry walls can remain; provide new blank cover plates as specified.
- M. Remove all abandoned wiring and cabling from below the raised floor and from above all ceilings.
- N. Remove existing conduit and wiring where no longer required, and remove them where they interfere with new construction.
 - 1. Remove wiring devices where shown on drawings and abandon boxes if they are in existing walls that are to remain. Provide blank cover plates for abandoned boxes, using cast corrosion resistant covers with gaskets for outdoor use.
 - 2. Remove abandoned conduit and wiring that would be exposed in finished areas. Cut conduit flush with finished floor, wall, and ceiling.
- O. Promptly remove used material from the site if it is no longer required. Where indicated, deliver used material to the Owner where directed on the site.
- P. Cut openings in existing beams, floors, walls, and other parts of the existing building without extra cost, regardless of the material encountered. Obtain approval of the design Professional before cutting structural members, and reroute electrical work to avoid such cutting if directed by the Design Professional.
 - 1. Saw cut and core drill existing concrete and paving. Cut reinforcing steel to provide a stub for connecting new reinforcing steel.
 - 2. Where floors and walls are penetrated, fill openings and spaces with Fire Resistant Sealant to retard spread of fire and smoke.
- Q. Conceal conduit in all finished locations. Cut and patch existing ceilings, walls, and structural members where necessary for concealment.
- R. Existing conduit already installed in the structure may be reused if it is in good condition.
 - 1. Where new wire is to be installed in existing conduit, disconnect and remove all existing wire. Replace existing wire with new wire of the same general characteristics and appropriate insulation, and draw replacement wire into the conduit along with the new wire. Reconnect existing wire and check entire system, placing it in approved operating condition. Nylon insulated wire may be used, if required, to meet conduit fill requirements of NEC.
- S. Provide sleeves through existing walls for all conduit and wiring.
- T. Perform additional renovation work as described in subsequent Sections of the Specifications.
- U. Provide other renovation work as required by job conditions.

- V. All existing devices being retained shall be lowered to comply with the latest ADA accessibility requirements and shall match the installation of new devices. Extend and reconnect wiring.

END OF SECTION 260510

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes building wire and cable; armored cable; metal clad cable; and wiring connectors and connections.
- B. Related Sections:
 - 1. Section 26 05 53 - Identification for Electrical Systems: Product requirements for wire identification.

1.3 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.4 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Stranded conductors for all motor connections.
 - 4. Conductor not smaller than 12 AWG for power and lighting circuits.

5. Conductor not smaller than 16 AWG for control circuits.
 6. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN -2 insulation, in raceway.
 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN -2 insulation, in raceway.
 3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN -2 insulation, in raceway.
 4. Wet or Damp Interior Locations: Use only building wire, Type XHHW -2 insulation, in raceway.
 5. Exterior Locations: Use only building wire, Type XHHW -2 insulation, in raceway.
 6. Underground Locations: Use only building wire, Type XHHW -2 insulation, in raceway.
 7. Provide Type XHHW-2 insulation for aluminum conductors.

1.5 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements, terminations, conductor ampacity and voltage drop. Copper conductors shall not be substituted with aluminum without prior approval from the Design Professional.

1.6 SUBMITTALS

- A. Product Data: Submit for building wire and each cable assembly type.
- B. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- C. Test Reports: Indicate procedures and values obtained.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and circuits.

1.8 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.10 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

PART 2 PRODUCTS

2.1 GENERAL BUILDING WIRE

- A. Manufacturers:
 - 1. AETNA.
 - 2. American Insulated Wire Corp.
 - 3. Colonial Wire.
 - 4. Encore Wire.
 - 5. General Cable Co.
 - 6. Republic Wire.
 - 7. Rome Cable.
 - 8. Service Wire Co.
 - 9. Southwire.
 - 10. Superior Essex.
 - 11. Carol Cable Co. Inc.
 - 12. Draka.
 - 13. Tyco.
 - 14. Pyrotenax.
 - 15. Raychem.
 - 16. Alcan Cable.
 - 17. AFC Cable Systems.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper, unless otherwise noted to be aluminum.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 90 degrees C.

2.2 METAL CLAD CABLE

- A. MC cable shall be a galvanized spiral steel assembly with 90°C THHN copper wires included and approved fittings and couplings by AFC Company. Cable shall have green insulated ground wire. Use only where cable can be concealed.
- B. MC cable shall be used only concealed in renovations in existing areas where walls and ceilings are not disturbed.

2.3 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install pre-insulated power distribution blocks for copper conductor splices and taps, 6 AWG and larger. Split bolt connectors are not acceptable.

5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.
 8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
 9. All motors shall be connected to their associated branch circuit with U.L. listed 3M motor lead splicing kits 5300 series and 3M Scotchlok copper compression lugs, 30000 series. (split bolt or twist on connectors are not acceptable).
- G. Install solid conductors for branch circuits 10 AWG and smaller.
- H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- I. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.
- K. Coordinate cable installation with other Work.
- L. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.
- M. Use pulling means including, fish tape, cable, rope and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- N. Conceal all cable in finished spaces.
- O. Keep conductor splices to a minimum.
- P. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cables in individual circuits. Make terminations so there is no bare conductor at the terminal.
- Q. Increase branch circuit wire size to limit voltage drop to 3% at full load conditions.
- R. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- S. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.

- T. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- U. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- V. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.
- W. Fasten identification markers to each electrical power supply wire/cable conductor which indicates their voltage, phase and feeder number.
- X. Unless otherwise indicated, each single-phase branch circuit shall consist of a respective insulated phase conductor, an insulated dedicated neutral conductor, and a separate insulated equipment ground wire.
- Y. All 120 V branch circuits between 60' and 100' in length shall be circuited with a minimum of #10 AWG wire. Branch circuits between 100' and 150' in length shall be circuited with a minimum of #8 AWG wire. Wire sizes shall be increased to limit voltage drop to three percent (3%).
- Z. Provide separate neutral conductor and ground wire for each branch circuit. Provide separate ground wire in each feeder circuit.

3.4 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.

- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.5 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.
- C. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.
- D. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.
- E. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper function. Correct malfunctioning units, and retest to demonstrate compliance.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Bonding and grounding.
- B. Related Sections:
 - 1. Section 27 05 26 - Grounding and Bonding for Communications Systems
 - 2. Section 28 05 26 - Grounding and Bonding for Electronic Safety and Security
- C. Applications of electrical grounding and bonding work in this section includes the following:
 - 1. Electrical power systems
 - 2. Raceways
 - 3. Enclosures
 - 4. Equipment
 - 5. Lighting fixtures
 - 6. Metal building frames
 - 7. Grounding electrodes
 - 8. Separately derived systems
 - 9. Underground metal piping
 - 10. Underground metal water piping
 - 11. Underground metal structures
 - 12. Service equipment
 - 13. Lighting standards
 - 14. Interior metallic piping
 - 15. Water service
 - 16. Lightning Protection
- D. GROUNDING AND BONDING IN GENERAL
 - 1. Except as otherwise indicated, provide electrical grounding and bonding systems indicated; with assembly of materials, including but not limited to, cables/wires, connectors, solderless lug terminals, bonding jumper braid, surge arresters and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is Installer's option. Where materials or components are not indicated,

provide products which comply with NEC, UL and IEEE requirements and with established industry standards for those applications indicated.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 99 - Standard for Health Care Facilities.

1.4 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.
 - 4. Ground ring.
 - 5. Rod electrode.
 - 6. Plate electrode.
 - 7. Concrete reinforcing.

1.5 DESIGN REQUIREMENTS

- A. Construct and test grounding systems for access flooring systems on conductive floors accordance with IEEE 1100.

1.6 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

1.7 SUBMITTALS

- A. Refer also to other Division 26, 27, and 28 sections.
- B. Comply as applicable with Section 01 33 00 – Submittal Procedures.
- C. Product Data: Submit data on grounding electrodes and connections.
- D. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- E. Manufacturer's Installation Instructions: Submit for active electrodes.

1.8 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.9 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum ten years documented experience.

1.11 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.13 COORDINATION

- A. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Erico, Inc.
 - 2. O-Z Gedney Co.
 - 3. Thomas & Betts, Electrical.
- B. Product Description:
 - 1. Material: Copper-clad steel.
 - 2. Diameter: 3/4 inch.
 - 3. Length: 10 feet.
- C. Connector: Connector for exothermic welded connection.

- D. Spacing: 10 feet between rods, 3 to 8 feet from building perimeter.
- E. Interconnect rods with minimum #4 AWG soft drawn bare copper buried minimum 12 inches below grade, unless indicated to be larger.

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: #4/0 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.
- E. Unless otherwise indicated, provide electrical grounding conductors for grounding system connections that match power supply wiring materials and are sized according to NEC or as shown on the drawings if oversized by Engineer.
- F. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 4 AWG and larger shall be permitted to be identified per NEC.
- G. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 10 AWG and smaller shall be ASTM B1 solid bare copper wire.
- H. Isolated Power System: Type XHHW-2 insulation with a dielectric constant of 3.5 or less.
- I. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.
- J. Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be a 1/0 AWG insulated stranded copper grounding conductor unless indicated otherwise.

2.3 ELECTRICAL GROUNDING CONNECTION ACCESSORIES

- A. Provide electrical insulating tape, heat shrinkable insulating tubing, welding materials, bonding straps, as recommended by accessories manufacturers for type service indicated.

2.4 BONDING JUMPER BRAID

- A. Copper braided tape, constructed of 30-gauge bare copper wires and properly sized for indicated applications.

2.5 FLEXIBLE JUMPER STRAP

- A. Flexible flat conductor, 480 strands of 30-gauge bare copper wire; 3¼" wide, 9½ " long; 48, 250 CM. Select braid with holes sized for 3/8" diameter bolts, and protect braid with copper bolt hole ends.

2.6 BONDING PLATES, CONNECTORS, TERMINALS, AND CLAMPS

- A. Provide bonding plates, connectors, terminals, lugs, and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for indicated applications.

2.7 SPLICES AND TERMINATION COMPONENTS

- A. Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.8 TELECOMMUNICATION SYSTEM GROUND BUSBARS

- A. Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 1/4 inch for wall and backboard mounting using standard insulators sized as follows:
- B. Room Signal Grounding: 13.5 inches x 4 inch. (Located in each Server Room, IDF, Sound Room, and AV Closet).
- C. Master Signal Ground: 23 inches x 4 inch. (Located in MDF).

2.9 GROUND CONNECTIONS

- A. Below Grade: Exothermic-welded type connectors.
- B. Above Grade:
 - 1. Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - 2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.
 - 3. Rack and Cabinet Ground Bars: one-hole compression-type lugs using zinc-plated or copper alloy fasteners.
 - 4. Cable Shields: Make ground connections to multipair communications cables with metallic shields using shield bonding connectors with screw stud connection.
 - 5. Equipment rack and cabinet ground bars. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks with minimum dimensions of 3/8 inch x 3/4 inch.

2.10 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.11 SPLICE CASE GROUND ACCESSORIES

- A. Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 6 AWG insulated ground wire with shield bonding connectors.

2.12 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS by 24 inches long clay tile, or concrete pipe with belled end.

- B. Well Cover: Cast iron or fiberglass with legend "GROUND" embossed on cover.

2.13 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Erico, Inc.
 - 2. ILSCO Corporation.
 - 3. O-Z Gedney Co.
 - 4. Thomas & Betts, Electrical.
- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.14 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Copperweld, Inc.
 - 2. ILSCO Corporation.
 - 3. O-Z Gedney Co.
 - 4. Thomas & Betts, Electrical.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Installer of grounding shall examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods as specified.

3.4 INSTALLATION

- A. General: Install electrical grounding and bonding systems as indicated, in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

- B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.
- C. Terminate feeder and branch circuit insulated equipment grounding conductors with grounding lug, bus or bushing.
- D. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.
- E. Route grounding connections and conductors to ground and protective devices in shortest and straightest paths as possible to minimize transient voltage rises.
- F. Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- G. Route properly sized (NEC Article 250) grounding conductors with each feeder and branch circuit.
- H. Ground each separately-derived system as follows:
 - 1. The grounded conductor of the separately derived system shall be bonded to the nearest available point of the interior metal water piping system in the area served by the separately derived system. This connection shall be made at the same point on the separately derived system where the grounding electrode conductor is connected. The bonding jumper shall be sized in accordance with the NEC.
- I. Connect together system neutral, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors and plumbing systems.
- J. Install grounding and bonding conductors concealed from view.
- K. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- L. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.
- M. Permanently attach equipment and grounding conductors prior to energizing equipment.
- N. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

- O. Install rod electrodes approximately every 60 feet around perimeter of building interconnected with #4/0 ground wire.
- P. Install grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- Q. Install grounding electrode conductor and connect to reinforcing steel in foundation footing. Electrically bond steel together.
- R. Bond together metal siding not attached to grounded structure; bond to ground.
- S. Bond together reinforcing steel and metal accessories in fountain structures.
- T. Connect to site grounding system, and each exterior lighting pole.
- U. Bond to lightning protection system.
- V. Install continuous grounding for underground cold water system and building steel.
- W. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 SYSTEM GROUNDING

- A. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
- B. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

3.6 EQUIPMENT GROUNDING

- A. Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.7 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.8 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

- A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.
- B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium or high voltage conductors, sized per NEC except that minimum size shall be #4/0 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions of medium or high voltage cable splices and terminations, and equipment enclosures.

- C. Lighting Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.
- D. Metallic Conduit: Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a bare grounding conductor to the equipment ground bus.

3.9 SECONDARY EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
 - 2. Provide a supplemental ground electrode and bond to the grounding electrode system.
- C. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors.
- D. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
 - 1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
 - 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- E. Transformers
 - 1. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system or the ground bar at the service equipment.
 - 2. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
- F. Conduit Systems
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - 2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - 3. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- G. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

- H. Boxes, Cabinets, Enclosures, and Panelboards
 - 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes.
 - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- I. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- J. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- K. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- L. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.10 CORROSION INHIBITORS

- A. When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.11 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.12 LIGHTNING PROTECTION SYSTEM

- A. Bond the lightning protection system to the electrical grounding electrode system.

3.13 ELECTRICAL ROOM GROUNDING

- A. Building Earth Ground Busbars: Provide ground busbar hardware at each electrical room and connect to pigtail extensions of the building grounding ring.

3.14 TELECOMMUNICATIONS SYSTEM

- A. Bond telecommunications system grounding equipment to the electrical grounding electrode system.
- B. Furnish and install all wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.
- C. Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.

- D. Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.
- E. Below-Grade Grounding Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with the manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and thoroughly cleaned the joint area. Notify the Resident Engineer prior to backfilling any ground connections.
- F. Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- G. Bonding Jumpers:
 - 1. Use insulated ground wire of the size and type shown on the Drawings or use a minimum of 6 AWG insulated copper wire.
 - 2. Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 - 3. Use compression connectors of proper size for conductors specified. Use connector manufacturer's compression tool.
- H. Bonding Jumper Fasteners:
 - 1. Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
 - 2. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
 - 3. Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
 - 4. Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.15 COMMUNICATION ROOM GROUNDING (MDF/IDF/SOUND/AV)

- A. Telecommunications Ground Busbars:
 - 1. Provide communications room telecommunications ground busbar hardware at 18 inches above finish floor, unless otherwise noted.
 - 2. Connect the telecommunications room ground busbars to other room grounding busbars provided by the information Technology Contractor.
- B. Telephone-Type Cable Rack Systems: aluminum pan installed on telephone-type cable rack serves as the primary ground conductor within the communications room. Make ground connections by installing the following bonding jumpers:
 - 1. Install a 6 AWG bonding between the telecommunications ground busbar and the nearest access to the aluminum pan installed on the cable rack.
 - 2. Use 6 AWG bonding jumpers across aluminum pan junctions.

- C. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
 - 1. When ground bars are provided at the rear of lineup of bolted together equipment racks, bond the copper ground bars together using solid copper splice plates supplied by the ground bar manufacturer.
 - 2. Bond together nonadjacent ground bars on equipment racks and cabinets with 6 AWG insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
 - 3. Provide a 6 AWG bonding jumper between the rack and/or cabinet ground busbar and the aluminum pan of an overhead cable tray or the raised floor stringer as appropriate.
- D. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near the top of backboards used for communications cross-connect systems. Connect backboard ground terminals to the aluminum pan in the telephone-type cable tray using an insulated 16 AWG bonding jumper.
- E. Bond each conduit interconnecting the telecommunications rooms to the ground busbar.
 - 1. Other Communication Room Ground Systems: Ground all metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to the cable tray pan or the telecommunications ground busbar, whichever is closer, using insulated 6 AWG ground wire bonding jumpers.

3.16 COMMUNICATIONS CABLE GROUNDING

- A. Bond all metallic cable sheaths in multipair communications cables together at each splicing and/or terminating location to provide 100 percent metallic sheath continuity throughout the communications distribution system.
 - 1. At terminal points, install a cable shield bonding connector provide a screw stud connection for ground wire. Use a bonding jumper to connect the cable shield connector to an appropriate ground source like the rack or cabinet ground bar.
 - 2. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or the splice case grounding and bonding accessories provided by the splice case manufacturer. When an external ground connection is provided as part of splice closure, connect to an approved ground source and all other metallic components and equipment at that location.

3.17 COMMUNICATIONS CABLE TRAY SYSTEMS

- A. Bond the metallic structures of one cable tray in each tray run following the same path to provide 100 percent electrical continuity throughout this cable tray systems as follows:
 - 1. Splice plates provided by the cable tray manufacturer can be used for providing a ground bonding connection between cable tray sections when the resistance across a bolted connection is 10 milliohms or less. The Contractor shall verify this loss by testing across one splice plate connection in the presence of the Contractor.
 - 2. Install a 6 AWG bonding jumper across each cable tray splice or junction where splice plates cannot be used.
 - 3. When cable tray terminations to cable rack, install 6 AWG bonding jumper between cable tray and cable rack pan.
 - 4. Bond cable tray to interconnecting conduit system.

3.18 COMPUTER ROOM GROUNDING

- A. Conduit: ground and bond metallic conduit systems as follows:
 - 1. Ground metallic service conduit and any pipes entering or being routed within the computer room at each end using 6AWG bonding jumpers.
 - 2. Bond at all intermediate metallic enclosures and across all joints using 6 AWG bonding jumpers.

3.19 WIREWAY GROUNDING

- A. Bond the metallic structures of wireway to provide 100 percent electrical continuity throughout the wireway system by connecting a 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
- B. Install insulated 6 AWG bonding jumpers between the wireway system bonded as required in paragraph 1 above, and the closest building ground at each end and approximately every 50 feet.
- C. Use insulated 6 AWG bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and cross all section junctions.
- D. Use insulated 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 30 feet.

3.20 COMMUNICATION RACEWAY GROUNDING

- A. Conduit: Use insulated 6 AWG bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- B. Wireway: use insulated 6 AWG bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.
- C. Cable Tray Systems: Use insulated 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 50 feet.

3.21 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.
- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Below-grade connections shall be visually inspected by the Owner prior to backfilling. The Contractor shall notify the Owner 24 hours before the connections are ready for inspection.

3.22 GROUND ROD INSTALLATION

- A. Drive each rod vertically in the earth, not less than 10 feet in depth.
- B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- C. Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.23 GROUNDING FOR RF/EMI CONTROL

- A. Install bonding jumpers to bond all conduit, cable trays, sleeves and equipment for low voltage signaling and data communications circuits. Bonding jumpers shall consist of 4 inches wide copper strip or two 10 AWG copper conductors spaced minimum 4 inches apart. Use 6 AWG copper where exposed and subject to damage.
- B. Comply with the following when shielded cable is used for data circuits.
 - 1. Shields shall be continuous throughout each circuit.
 - 2. Connect shield drain wires together at each circuit connection point and insulate from ground. Do not ground the shield.
 - 3. Do not connect shields from different circuits together.
 - 4. Shield shall be connected at one end only. Connect shield to signal reference at the origin of the circuit. Consult with equipment manufacturer to determine signal reference.

3.24 FIELD QUALITY CONTROL

- A. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- B. Perform ground resistance testing in accordance with IEEE 142.
- C. Perform continuity testing in accordance with IEEE 142.
- D. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.

- E. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH - Certification Listings.

1.4 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.5 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction in accordance with FM, UL, and WH.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.6 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code FM, UL, and WH for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.7 SUBMITTALS

- A. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- B. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- E. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.8 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 10 years documented experience.

1.10 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company.
 - 3. O-Z Gedney Co.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves for conduit Through Non-fire Rated Floors: Steel pipe.
- B. Sleeves for conduit, bus duct, and cable tray Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- C. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products.
 - 6. Specified Technology, Inc.
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single or Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single or Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral and ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: As selected from manufacturer's full range of colors.

2.6 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.

- 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
- 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
- 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Obtain permission from Design Professional before using powder-actuated anchors.
- E. Do not drill or cut structural members.
- F. Obtain permission from Design Professional before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors, and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Provide expansion anchors.

4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 6. Sheet Metal: Provide sheet metal screws.
 7. Wood Elements: Provide wood screws.
- B. Inserts:
1. Install inserts for placement in concrete forms.
 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
 4. Support vertical conduit at every floor.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Remove dam material after firestopping material has cured.

- G. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where cable tray, bus, cable bus, conduit, wireway, and trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons, floor plates, and ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- B. Construct supports of steel members and formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 3 inches above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 260529

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SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 3. Section 26 05 53 - Identification for Electrical Systems.
 - 4. Section 26 27 16 - Electrical Cabinets and Enclosures.
 - 5. Section 26 27 26 - Wiring Devices.
 - 6. Section 26 70 00 - Conduits and Backboxes for Communications Systems.
 - 7. Section 27 05 26 - Grounding and Bonding for Communications Systems
 - 8. Section 27 05 28 - Pathways for Communications Systems
 - 9. Section 27 05 36 - Cable Trays for Communications Systems
 - 10. Section 28 05 28 - Pathways for Electronic Safety and Security
 - 11. Section 28 05 44 - Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Wiring Methods
 1. Interior Wiring
 - a. Feeders - Electrical Metallic Tubing (EMT) where exposed (not subject to physical damage) or concealed in walls, floors, and above ceilings. Not to be encased in concrete or installed outdoors.
 - b. Branch Circuits - Electrical Metallic Tubing (EMT) where exposed (not subject to physical damage) or concealed in walls, floors, and above ceilings. Not to be encased in concrete or installed outdoors.
 - c. Metal Clad Cable (MC) - Concealed in renovations in existing areas where walls and ceilings are not disturbed.
 - d. Voice/Data/Video - Electrical Metallic Tubing (EMT), where exposed or concealed in walls and floors.
 - e. Fire Alarm - Electrical Metallic Tubing (EMT) where exposed and Plenum Rated cable where concealed in walls and above ceilings.
 - f. Building Controls - Electrical Metallic Tubing (EMT).
 - g. Connection to Vibrating Equipment - Flexible Metallic Conduit (FMC) to six (6) feet maximum in length.
 - h. Connection to Pumps - Liquid-Tight Flexible Metallic Conduit (LFMC) to six (6) feet maximum in length.
 2. Exterior Wiring Below Grade
 - a. Feeders – Schedule 40 Non-Metallic Conduit (PVC).
 - b. Branch Circuits – Schedule 80 Non-Metallic Conduit (PVC).
 - c. Control Circuits – Schedule 80 Non-Metallic Conduit (PVC).
 - d. PVC transition to above grade/slab - Galvanized Rigid Steel Conduit (GRS).
 - e. PVC transition to inside building - Galvanized Rigid Steel Conduit (GRS).
 - f. Link-seals for all conduits entering building horizontally above and below grade.
 - g. Rigid aluminum conduit in contact with soil or concrete shall have supplementary corrosion protection (bitumastic paint, tape wraps approved for the purpose, or PVC coated conduit.)
 - h. GRS shall be joined with threaded-type fittings.
 3. Exterior Wiring Above Grade
 - a. Feeders – Galvanized Rigid Steel Conduit (GRS).

- b. Branch Circuits – Galvanized Rigid Steel Conduit (GRS).
 - c. Control Circuits – Galvanized Rigid Steel Conduit (GRS).
 - d. Connection to Vibrating Equipment - Liquid-Tight Flexible Metallic Conduit (LFMC) to six (6) feet maximum in length.
 - e. GRS shall be joined with threaded-type fittings.
- 4. Fire Alarm Wiring
 - a. SLC and NAC – Electrical Metallic Tubing (EMT) where exposed. Plenum rated cable shall be used where concealed in walls and above ceilings.
- C. All raceways through walls and floors shall be provided with steel sleeves.
- D. All exposed conduits shall be provided with escutcheon plates.
- E. All conduits shall be minimum 3/4" in size with threaded or compression fittings.
- F. Maximum length of flexible metal conduit will be six feet.
- G. All conduits will receive insulated bushings or nylon throats.
- H. Separate ground wires will be provided in each raceway.
- I. Each branch circuit will be provided with dedicated neutral conductors.
- J. Fire rated sleeve assemblies will be provided in all walls and floors for low voltage cabling.
- K. Conductor sizes are based on copper unless indicated as aluminum or "AL". When aluminum conductor is substituted for copper conductor, size to match circuit requirements for conductor ampacity and voltage drop.
- L. Raceway and boxes are located as indicated on Drawings, and at other locations where required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements.
- M. Raceway Products:
 - 1. Outdoor Locations, Above Grade: Provide cast metal outlet, pull, and junction boxes.
 - 2. Wet and Damp Locations: Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
 - 3. Concealed Dry Locations: Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
 - 4. Exposed Dry Locations: Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.5 DESIGN REQUIREMENTS

- A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.6 SUBMITTALS

- A. Refer also to other Division 26, 27, and 28 sections.
- B. Comply as applicable with Section 01 33 00 – Submittal Procedures.
- C. Product Data: Submit for the following:
 - 1. Conduit and EMT.
 - 2. Flexible metal conduit.
 - 3. Liquidtight flexible metal conduit.
 - 4. Raceway fittings.
 - 5. Conduit bodies.
 - 6. Wireway.
 - 7. Pull and junction boxes.
 - 8. Surface Raceway.
- D. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.7 CLOSEOUT SUBMITTALS

- A. Comply as applicable with Section 01 77 00 – Closeout Documents.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inches.
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.9 COORDINATION

- A. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit
 - 2. Cal Pipe Industries, Inc.
 - 3. Wheatland Tube
 - 4. Republic Conduit
 - 5. Thomas & Betts
 - 6. Western Tube & Conduit Corporation
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. AFC Cable Systems
 - 3. Anamet Electrical (Anaconda Sealtight).
 - 4. Electri-Flex Company
 - 5. Encore Wire Corporation
 - 6. International Metal Hose Company
 - 7. Southwire Company
- B. Product Description: Interlocked steel, aluminum construction.
- C. Fittings: NEMA FB 1.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. AFC Cable Systems
 - 3. Anamet Electrical (Anaconda Sealtight).
 - 4. Electri-Flex Company
 - 5. Encore Wire Corporation
 - 6. International Metal Hose Company
 - 7. Southwire Company
- B. Product Description: Interlocked aluminum construction with PVC jacket.
- C. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit
 - 2. Cal Pipe Industries, Inc.
 - 3. Wheatland Tube
 - 4. Republic Conduit
 - 5. Thomas & Betts
 - 6. Western Tube & Conduit Corporation
- B. Product Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel, compression type.

2.5 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. AFC Cable Systems
 - 2. Allied Tube & Conduit
 - 3. National Pipe & Plastics
 - 4. Southern Pipe
 - 5. Cantex
 - 6. Pacific Plastics
 - 7. JM Eagle
 - 8. Carlon
- B. Product Description: NEMA TC 2; Schedule 80 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.6 WIREWAY

- A. Manufacturers:
 - 1. Eaton
 - 2. Wiegmann
 - 3. Millbank
 - 4. Pentair
 - 5. Rittal
 - 6. Thomas & Betts Corp.
 - 7. Hoffman
 - 8. Hammond
- B. Product Description: General purpose type wireway.
- C. Knockouts: Manufacturer's standard.
- D. Size: One size larger than required by NEC.
- E. Cover: Hinged cover.
- F. Connector: Slip-in.

- G. Fittings: Lay-in type with removable top, bottom, and side; captive screws.
- H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.7 OUTLET BOXES

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Raco
 - 7. Cooper
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- C. Nonmetallic Outlet Boxes: NEMA OS 2.
- D. Cast Boxes: NEMA FB 1, Type FD, aluminum or cast ferrous alloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.8 PULL AND JUNCTION BOXES

- A. Manufacturers:
 - 1. Eaton
 - 2. Wiegmann
 - 3. Millbank
 - 4. Pentair
 - 5. Rittal
 - 6. Thomas & Betts Corp.
 - 7. Hoffman
 - 8. Hammond
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Hinged Enclosures: As specified in Section 26 27 16.
- D. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron or Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- E. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:
 - 1. Material: Galvanized cast iron or Cast aluminum.

2. Cover: Smooth cover with neoprene gasket and stainless steel cover screws.
 3. Cover Legend: "ELECTRIC".
- F. Concrete composite Handholes: Die-molded, concrete composite hand holes:
1. Conduit Entrance: Field core bored conduit entrance on each side.
 2. Cover: Glass-fiber concrete composite. Weatherproof cover with nonskid finish.
 3. Provide solid bottoms and gasketed cover.

2.9 SLEEVES

- A. Sleeves for Conduit, Cable Tray and Wiring Through Non-Fire Rated Floors: Steel pipe.
- B. Sleeves for Conduit, Cable Tray and Wiring Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe.
- C. Sleeves for Conduit, Cable Tray and Wiring Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

2.10 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
1. Thunderline Link-Seal, Inc.
 2. NMP Corporation.
 3. Substitutions: Not Permitted.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.11 FIRESTOPPING

- A. Comply as applicable with Division 7 – Thermal Protection
- B. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
- C. Foam Firestopping Compounds: Multiple component foam compound.
- D. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
- E. Fiber Stuffing and Sealant Firestopping: Composite of mineral or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
- F. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
- G. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

- H. Firestop Pillows: Formed mineral fiber pillows.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The drawings are generally indicative of the work to be performed but do not indicate all bends, fittings, boxes and specialties which may be required or the exact locations affecting all the work. Contractor shall arrange the work accordingly, and furnish such fittings as may be required to meet such conditions at no additional cost to the Owner, and arrange all vertical runs of conduit to clear beams, ductwork, mechanical equipment, and other obstructions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. All concealed conduit shall be placed in walls, floors, ceilings, or slabs at the proper time in accordance with the progress of meeting schedules and shall not delay the structural work unnecessarily. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during pouring of the concrete. Where conduit interferes with structural steel, steel reinforcement, or in the opinion of the Engineer occupies too much space in the slab, the conduits shall be rearranged or installed exposed as directed by the Design Professional. No additional payment will be made for such rearrangement of conduit whether or not additional conduit or fittings might be required.
- B. Exposed service entrance conduits and main feeder conduits shall be identified using stenciled letters at intervals not to exceed 20 feet. Size of letters shall be equal to $\frac{1}{2}$ the diameter of the conduit or 2 inches, whichever is less.
- C. Conduit joints shall be made up tight using a pipe wrench. Channel lock pliers will not be permitted, and unions shall be used as necessary to aid in the installation. Conduits shall be square and the ends reamed smooth after threading to prevent injury to conductors. Conduit joints in concrete or exposed to

weather or damp locations shall be drawn up tight and coated with insulating paint before casting in concrete or painting exposed conduit system.

- D. Bends and turns shall be made using long sweeps. Ninety-degree bends will be used only where required and shall be kept at a minimum.
- E. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system. Arrange raceway supports to prevent misalignment during wiring installation. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- B. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- C. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- D. Do not attach raceway to ceiling support wires or other piping systems.
- E. Construct wireway supports from steel channel specified in Section 26 05 29.
- F. Cut conduit square using saw or pipe cutter; de-burr cut ends. Bring conduit to shoulder of fittings; fasten securely.
- G. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- H. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- I. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate bends in metal conduit larger than 2 inch size.
- J. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- K. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- L. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- M. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- N. Close ends and unused openings in wireway.

- O. Conceal all conduit unless indicated otherwise, within finished walls, ceilings, floors, and existing construction. Keep raceways at least twelve inches away from parallel runs of flues, steam, and hot water pipes. Install raceways level and square and at proper elevations.
- P. Elevation of Raceway: Where possible, install horizontal raceway runs above all piping, and mechanical ducts tight to ceiling.
- Q. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- R. Install all raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. Run exposed, parallel, or banked raceways together.
- S. Communication System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways 2-inch and smaller trade size in maximum lengths at 100 feet and with a maximum of two 90 deg. bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
- T. All conduits shall be securely supported by individual ring hangers and rods, steel trapeze hangers or galvanized malleable iron pipes fastened to concrete slabs, beams or bar joists or from beam clamps attached to the structural members of the building.
- U. The arrangement of all conduits and the methods of fastening same shall be subject to the direction and approval of the Engineer and Architect. Power and branch circuit conduits shall be installed so that not more than the equivalent of three 90 degree bends occur in any one run. If a greater number of bends is required, a junction box shall be installed.
- V. Raceways, boxes, etc. above suspended ceiling shall be supported directly from structure, independent of ceiling system, duct, piping, or other work.
- W. All metal conduit enclosures and raceways for conductors shall be mechanically joined to form a continuous electrical conductor, and shall be so connected to all electrical boxes, fittings, and cabinets as to provide effective electrical continuity and firm mechanical assembly.

3.5 INSTALLATION - BOXES

- A. Outlet boxes to be furnished and installed by this Contractor shall consist of the various types of outlet boxes required for wiring devices, lighting fixtures and all other equipment as required for the electrical work. The extent of the outlet boxes shall be as shown on the drawing and as required. Boxes shall be manufactured by Steel City or approved equal.
- B. The exact location of outlets shall be obtained from the drawings of interior details and finishes. In locating outlets, caution shall be taken to allow for overhead pipes, ducts, variations in arrangement, thickness of finish window trim, paneling, door swings, and other architectural construction. All lighting fixture outlets shall be located symmetrically within areas. Any inaccuracy in locating outlets shall be corrected without additional expense to the Owner. Any condition that would place an outlet box in an unsuitable location, such as a molding or break in wall finish shall be referred to the Architect for a more desirable location. All outlet boxes shall be securely fastened. Exposed outlet boxes shall be attached to permanent inserts or lead anchors with machine screws. All unused openings in outlet boxes shall be closed with knockout closers manufactured for that purpose.

- C. Blank plates shall be installed on the outlet boxes on which no apparatus is installed, or if the apparatus installed does not provide a suitable cover for box.
- D. Contractor shall submit a schedule of installation heights for coordination and approval by the Design Professional prior to final roughing-in.
- E. Contractor shall be responsible that locations of outlets do not interfere with mechanical construction or architectural features.
- F. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings and as specified in section for outlet device.
- G. Adjust box location up to 10 feet prior to rough-in to accommodate
- H. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- I. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- J. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- K. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- L. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- M. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- N. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- O. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- P. Install adjustable steel channel fasteners for hung ceiling outlet box.
- Q. Do not fasten boxes to ceiling support wires or other piping systems.
- R. Support boxes independently of conduit.
- S. Install gang box where more than one device is mounted together. Do not use sectional box.
- T. Install gang box with plaster ring for single device outlets.

3.6 STUB-UP CONNECTIONS

- A. Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor.

3.7 FLEXIBLE CONNECTIONS

- A. Use short length of flexible conduit for equipment subject to vibration, noise transmission or movement; and for all motors, transformers, dimmer panels/racks, and light fixtures. Use liquidtight flexible conduit in wet locations, inside air handling units, and all pump motors. Install separate ground conductor across flexible connections.

3.8 FITTINGS

- A. All couplings and fittings for EMT shall be steel, contain nylon insulated throats and shall be raintight – either the gland and ring compression type or the stainless steel multiple point locking type, as manufactured by Thomas & Betts or approved equal. Fittings using sets of screws or indentations as a means of attachment will not be permitted.
- B. Locknuts, bushings and other fittings for standard rigid conduit shall be made of steel or malleable iron; changes in direction or runs shall be made with symmetrical bends of cast metal fittings as manufactured by Crouse-Hinds or approved equal.
- C. Raceways crossing expansion joints shall be provided with suitable expansion fittings.
- D. Where rigid conduit is installed in a cabinet, junction box, pull box, or auxiliary gutter, the conductors shall be protected by a nylon insulated metallic bushings as manufactured by Thomas & Betts or approved equal. Locknut shall be installed outside the enclosure. Conduit bushings 1 ½" and larger shall be provided with a copper grounding lug with pressure type wire terminal.

3.9 INSTALLATION OF CONCEALED CONDUIT

- A. Conduit work shall be concealed in all finished portions of the building. Where conduits are to be imbedded in concrete, they shall be placed so as not to interfere with the proper placement of the reinforcing bars.
- B. Conduit shall be installed so as not to damage structural members. The approval of the Design Professional will be required to run conduit through columns, beams, or structural members.
- C. Horizontal or crossruns in building-type partitions or side walls shall be avoided. All conduit to outlets in building-type partitions shall be run down from ceiling or up from slab into the partition. Conduit shall be run in the slab parallel to the partition, a minimum of 6" before making turn-up.

3.10 INSTALLATION OF EXPOSED RACEWAYS

- A. Exposed, raceways, where permitted, and extensions from concealed conduit shall be neatly run, parallel with or at tight angles to the walls of the building. Where connection to overhead exposed raceways are required to be run down walls, vertical run of conduit shall be concealed within the new or existing wall to switchlegs, receptacles, panelboards, etc.
- B. Exposed raceways shall be supported from ceilings or walls approved hangers, ceiling trapeze, clamps or clips fastened by machine screws to expansion sleeves, inserts or lead anchors. Conduit shall be supported on each side of bends. Spacing of clamps or hangers for supporting conduit from ceiling or walls shall not be greater than 5' apart.

- C. Connections to motor terminal boxes shall be made by the use of flexible steel conduit not to exceed 18" in length, and shall be of the same size as the conduit to which it connects, grounded per N.E.C. requirements.

3.11 GROUNDING

- A. Electrically ground raceways and ensure continuous electrical conductivity.

3.12 SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seal.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Install sleeves where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight.

3.13 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified in Section.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.14 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

3.15 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260533

SECTION 260548 - NOISE AND VIBRATION CONTROL FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this section.

1.2 WORK INCLUDED

- A. Vibration Isolation
- B. Sealing Around Penetrations Through Walls and Slabs
- C. Sealant
- D. Installation of flexible conduit between non-isolated construction and isolated construction, including mechanical equipment, fans, pumps, and bridging between isolated room-within-a-room and non-isolated adjacent construction.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Consult all other Sections to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner.
- B. Installation of Transformers
- C. Performance Lighting System
- D. Electric Service Distribution
- E. Concrete Housekeeping Pads
- F. General Lighting Systems

1.4 DEFINITIONS

- A. The term "or as approved" means the contractor may propose an alternate product, but the consultant shall be sole judge of acceptability of alternate products. The term "Contractor" as used in this Section refers to that contractor directly responsible for the supply and installation of the Electrical Systems, including noise and vibration control.

1.5 CONTRACTOR'S RESPONSIBILITY

- A. The Electrical Contractor shall be directly responsible for the supply and installation of noise and vibration control equipment and work for the Electrical Systems.
- B. The Contractor shall be responsible for providing a complete and suitable installation of isolation equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or on the drawings, shall be supplied by the Contractor without claim for additional payment.
- C. The Contractor shall provide seismic restraints for all vibration isolation systems where required by code. The Contractor shall submit drawings and specifications, certifying that the installation will meet all local seismic restraint requirements. The Contractor shall also certify that none of the required seismic restraints will reduce the isolation efficiency of any vibration isolation systems.
- D. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly with the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

1.6 MANUFACTURER'S RESPONSIBILITY

- A. Manufacturer of vibration isolation equipment shall have the following responsibilities:
 - 1. Determine vibration isolation for all equipment and systems in accordance with all codes and authorities having jurisdiction on this project.
 - 2. Provide equipment isolation systems as scheduled or specified.
 - 3. Guarantee specified isolation system deflection.
 - 4. Provide installation instructions, drawings, and field supervision to assure proper installation and performance.
 - 5. The vibration isolation systems shall be guaranteed to have deflection indicated on the schedule on the drawings. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.
 - 6. The vibration isolator vendor shall ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Where additional support structure is required, this shall be provided by vibration isolator vendor.

1.7 APPROVED MANUFACTURERS

- A. All noise and vibration control apparatus shall be furnished by a single manufacturer who has supplied isolation equipment for at least five years. The vendor shall design and provide all hangers, isolators, bases, pads, sleeves, and other devices specified, required, or detailed for the vibration isolation of all electrical equipment and conduit. The vendor for vibration control equipment shall be one of the following, or as approved:
 - 1. Mason Industries Inc.
 - 2. Amber-Booth
 - 3. Kinetics Noise Control

1.8 BID PROPOSALS

- A. The Contractor shall submit at the time of bidding the names and qualifications of the noise and vibration control supplier(s). If a supplier is not one of the pre-approved vendors, then the submittal shall be accompanied by a complete catalog of that supplier's products and samples of each proposed vibration isolator with reference to the specification part number.

1.9 SHOP DRAWINGS

- A. Fully coordinated shop drawings for all vibration and noise control equipment and systems shall be submitted by the Contractor for review by the Owner's Consultants. These submittals shall state the performance of the noise and vibration control products to be provided, such as, but not limited to, the following: vibration isolator model or type, size and static deflection; isolator location shown on an outline of the isolated equipment; seismic restraints; installation details; locations of isolated conduit hangers on conduit layout plans; materials and details for penetrations, including penetrations by groups of conduits, and locations of acoustically sealed pull boxes.
- B. Seismic restraints, including attachment calculations by the Seismic Restraint Manufacturer's licensed Engineer substantiating the seismic restraints are furnished and installed in accordance with local building codes. A registered professional engineer having a PE from the same state as the project, or state of restraint manufacturer shall stamp all analysis, or as required by local building codes.

1.10 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "Noise-Critical Spaces," require special attention (special acoustical provisions and restrictions). The table below designates the Noise-Critical Spaces:
 - 1. Glee Club Rehearsal Room
 - 2. Glee Club Sectionals
 - 3. Concert Band Rehearsal Room
 - 4. Spirit Band Room
 - 5. Control Room
 - 6. Office
 - 7. Corridors
 - 8. Mechanical and Electrical Rooms
 - 9. Sound, Communications, and AV Equipment Rooms
- B. Penetrations by ducts, pipes and conduit between Noise-Critical Spaces shall be sleeved, packed, and sealed airtight with non-hardening sealant, and treated with Acoustically Sealed Pull Boxes as described herein.

1.11 DESCRIPTION OF SYSTEMS

- A. VIBRATION ISOLATION

1. Vibration isolators shall be installed to attenuate the vibration transfer from equipment such as transformers, lighting dimmers, lighting ballasts, controls, and relays to reduce vibration.
2. Flexible connections shall also be supplied for conduit and wiring serving electrical equipment on vibration isolators to ensure complete isolation of such equipment.

B. TRANSFORMERS

1. Transformers shall be located only where shown on the drawings. The noise sensitivity of this facility requires that all noise critical spaces be well isolated from transformer noise and vibration.

C. SEALING OF PENETRATIONS

1. Electrical equipment generates "tuned" noise that can be very disturbing in performance spaces. Walls and doors within the cave can effectively isolate air-borne noises from noise critical spaces, but the effectiveness of sound isolating structures can be severely compromised by penetrations for electrical conduit. Proper sealing around and inside conduits passing through penetrations as described herein will maintain the integrity of the sound isolating structure.
2. Special "Acoustically Sealed Pull Boxes" shall be used where a group of conduits penetrate a noise critical wall. These heavy-duty, airtight pull boxes are used to reduce the leakage of sound through the conduit walls and thus through the structure.

PART 2 - PRODUCTS

2.1 MATERIALS

A. FOAM ROD

1. Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.

B. NON-HARDENING SEALANT

1. Sealant for electrical penetrations shall be non-hardening polysulphide type.
2. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise sensitive walls that are also fire rated.

2.2 EQUIPMENT

A. GENERAL

1. All equipment provided for vibration isolation or noise control shall be new and manufactured specifically for the purpose intended.

B. VIBRATION ISOLATORS

1. GENERAL

- a. The static deflection of isolators shall be as given in the equipment schedule and specified below.
 - b. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier to meet performance criteria below. Static deflections specified shall be met with equipment fully operational.
2. ISOLATOR TYPE WP
- a. Type WP (Waffle Pads) shall be minimum 5/16 in. thick neoprene pads ribbed or waffled on both sides. The pads shall be selected for 15 percent strain. Neoprene shall be bridge-bearing quality with a maximum durometer of 50. Where required to meet this strain criterion, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
(Type WP: Mason Industries Type W, Super W, or as approved.)
3. ISOLATOR TYPE MWP
- a. Type MWP (Metal and Waffle Sandwich Pads) shall consist of two 5/16 in. thick ribbed or waffle neoprene pads sandwiching a 16-gauge stainless steel plate. The pad shall be designed for 15 percent strain. Neoprene shall be bridge-bearing quality with a maximum durometer of 50. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
(Type MWP: Mason Industries Type WSW or as approved.)
4. ISOLATOR TYPE RBA
- a. Type RBA isolators shall be designed with a neoprene element to provide isolation in tension, shear, or compression. Neoprene shall be bridge bearing quality with a maximum durometer of 30.
(Type RBA: Mason Industries Type RBA or as approved.)
5. ISOLATOR TYPE DDNM
- a. Type DDNM (Double Deflection Neoprene Mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed, and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment. The strain on the neoprene shall not exceed 15 percent. Neoprene shall be bridge bearing quality with a maximum durometer of 50. DDNM mounts shall be selected for a static deflection of 3/8 in. unless otherwise specified.
(Type DDNM: Mason Industries Type ND or as approved.)
6. ISOLATOR TYPE DDNH
- a. Type DDNH (Double Deflection Neoprene Hangers) shall consist of a molded neoprene element in a steel hanger box. A neoprene sleeve shall be located where the lower hanger rod passes through the steel box supporting the isolator, such that the hanger rod cannot contact the steel hanger body. The diameter of the clear hole in the mounting box shall be

at least 3/4 in. larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30-degree arc. When installed, the hanger box shall be allowed to rotate through a full 360-degree arc without encountering any obstructions.

- b. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 in. with a strain not exceeding 15 percent. Neoprene shall be bridge-bearing quality with a maximum durometer of 50.

(Type DDNH: Mason Industries Type HD or as approved.)

7. ISOLATOR TYPE SPNM

- a. Type SPNM (Spring and Neoprene Mounts) shall be free standing and laterally stable without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80 percent of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50 percent of the specified static deflection.
- b. Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1 in., and the minimum static deflection for equipment mounted above grade level shall be 2 in.
- c. Two Type WP isolation pads sandwiching a 16-gauge stainless or galvanized steel separator plate shall be bonded to the isolator base plate.
- d. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.

(Type SPNM: Mason Industries Type SLFSW or as approved.)

8. ISOLATOR TYPE SPNH

- a. Type SPNH (Spring and Neoprene Hangers) shall consist of a steel spring in series with a neoprene element. The spring shall have a minimum additional travel to solid equal to 50 percent of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 in. with a strain not exceeding 15 percent. Neoprene shall be bridge-bearing quality with a maximum durometer of 50.
- b. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 in.
- c. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30-degree arc. A neoprene sleeve shall be inserted in the steel hanger box where the lower hanger rod passes through it, such that the hanger rod cannot contact the steel hanger body. The diameter of the clear hole in the mounting box shall be at least 3/4 in. larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360-degree arc without compromising a minimum clearance of 1 in.

(Type SPNH: Mason Industries Type 30N or as approved.)

9. NEOPRENE MOUNTING SLEEVES

- a. Neoprene mounting sleeves for hold-down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

10. ACOUSTICALLY SEALED PULL BOXES

- a. Sides and cover shall be formed of minimum 14-gauge cold rolled steel. Inside surfaces of sides and cover shall be lined with 1 in. thick, neoprene-coated duct liner board of 3 pcf density. Entire perimeter of closure shall be sealed with 1 in. x 1/4 in. closed-cell sponge neoprene sound seal. Sides of the box shall be sealed airtight to the wall with non-hardening sealant on foam backer rod. Conduit penetrations through wall shall be packed and caulked as described herein.

PART 3 - EXECUTION

3.1 GENERAL

- A. Ballasts, relays, dimmers, equipment controls and all transformers shall be located as shown on the drawings. If not shown, location is subject to review by architect and acoustical consultant prior to installation. Under no circumstances shall such devices be located within noise critical spaces or on walls, slabs or ceilings that are common to such spaces.

3.2 MECHANICAL

- A. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with flexible conduit having sufficient slack so as not to impede movement of equipment on isolators. This Contractor shall coordinate wiring connections with the Electrical Contractor.

3.3 TRANSFORMERS

- A. All transformers shall be supported on Type SPNM or SPNH. All wiring connections to transformers shall be made with flexible conduit having sufficient slack so as not to impede movement of equipment on isolators.
- B. Transformers shall not be hung from or supported on other equipment, pipes or ductwork installed on vibration isolators, but shall be supported on or suspended from building structure.

3.4 DIMMER RACKS

- A. Dimmer racks and other lighting equipment containing transformers, fans, choke coils or relays shall be installed on Type MWP isolation pads and shall be located a minimum of 3 in. from adjacent walls. Conduit within the dimmer rooms shall be suspended on Type DDNH neoprene hangers.

3.5 MOTORS AND ELECTRICAL EQUIPMENT

- A. All wiring connections to motors and electrical equipment supported on Type SPNM or Type SPNH isolators shall be made with a slack U-shaped section of flexible conduit. Wiring connections to motors and electrical equipment supported on Type DDNM and or Type DDNH isolators shall be made with a slack U-shaped flexible conduit. Flexible conduit and cable shall be capable of and recommended for such curvature.

3.6 MOTOR CONTROL CENTERS

- A. Motor control centers shall be mounted on Type MWP isolators.

3.7 SOUND SYSTEM RACKS

- A. All sound and communication racks shall be mounted on Type MWP isolators.

3.8 ACOUSTICALLY SEALED PULL BOXES

- A. Acoustically sealed pull boxes as described herein shall be installed at one side of each penetration at noise critical walls and slabs where the pull box exceeds 8 in. in at least one dimension.

3.9 PENETRATIONS OF WALLS AND SLABS

- A. All conduit and cable penetrations of noise critical spaces shall be sleeved, packed, and caulked airtight.
- B. Where a conduit or cable passes through such a wall or slab, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be larger than the external diameter of the conduit passing through it by 2 in. for conduit 2 in. and over and by 1 in. for conduit under 2 in. After all conduit is installed, the Electrical Contractor shall check the clearance and correct it, if necessary, to within 1/2 in. The void shall be packed full depth with glass fiber; install foam backer rod on both sides, recessed into the sleeve by 1/2 in. Cover the backer rod 1/2 in. deep with non-hardening, non-aging sealant. Alternatively, the void between sleeve and conduit shall be filled full depth with GE silicone sealant Type RTV6428 or approved material with equal density and flexibility. For penetrations in fire-rated assemblies, use approved non-hardening, non-shrinking fire stop putty in lieu of the sealant and foam rod.
- C. Where conduit crosses a building expansion joint between new and existing buildings, an 18 in. length of flexible conduit shall be used to bridge between the two constructions. Rigid conduit shall not be acceptable.
- D. Back-boxes in acoustically rated partitions shall be wrapped with 1/4 in. thick permanently flexible fire-stop putty pads, and sealed airtight at gypsum board finish and any penetrating conduit with fire-stop putty or non-hardening acoustical sealant. Back-boxes shall be installed at least 24 inches apart. Under no circumstances shall back-boxes be installed back-to-back.
- E. Back-boxes of greater than size 4-gang in acoustically rated partitions shall be wrapped with 5/8 in. thick gypsum wall board, and sealed airtight at gypsum board wall finish and any penetrating conduit with fire-stop putty or non-hardening acoustical sealant. Back-boxes shall be installed at least 24 inches apart. Under no circumstances shall back-boxes be installed back-to-back.

3.10 FIELD QUALITY

- A. Contractor shall work in accord with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult and coordinate with trades doing adjoining work in order to provide an installation of first-class quality.

3.11 TESTING AND ADJUSTMENT

- A. Contractor shall test and adjust noise and vibration control products and installations to achieve specified performance.

3.12 CONTRACTOR'S REPORT

- A. The vibration isolation manufacturer shall inspect and approve the installation of the vibration isolators and shall submit a report to the Architect and Acoustics Consultant which verifies that all of the isolators for electrical equipment has been properly installed and that the installation is in full conformance with the specification. The report shall contain the type and measured static deflection of all spring isolators provided.

3.13 SITE ACCESS

- A. During installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and Acoustics Consultant.

3.14 CONSULTANT'S INSPECTION

- A. Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify in writing the Architect, who will schedule an inspection by the Acoustics Consultant. The letter shall certify that all work specified under this section is complete, operational, and adjusted in every respect, and that all work is ready for the completion checkout. Defective equipment and installation shall be repaired at the cost of the Contractor, and another inspection shall be scheduled.
- B. In the event that a second (or subsequent) inspection is required, the Contractor shall reimburse the Owner for travel, food and accommodation expenses incurred by the Consultant and passed on to the Owner.
- C. For each inspection, workers shall be furnished to perform such functions as are necessary for inspection of the equipment.

END OF SECTION 26 05 48

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.

1.3 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
 - 3. Submit two samples of each type of identification products applicable to project.
 - 4. Submit two nameplates, 4 x 4 inch in size illustrating materials and engraving quality.
- B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept identification products on site in original containers. Inspect for damage.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.8 EXTRA MATERIALS

- A. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 - 1. SETON.
- B. Product Description: Laminated three-layer plastic with engraved white letters on black contrasting background color.
- C. Letter Size:
 - 1. 1/8 inch high letters for identifying individual equipment and loads.
 - 2. 1/4 inch high letters for identifying grouped equipment and loads.
 - 3. 1/2 inch high letters for identifying equipment.
- D. Minimum nameplate thickness: 1/8 inch.
- E. Fastening; Mechanically attached.

2.2 LABELS

- A. Manufacturers:
 - 1. SETON
- B. Labels: Pressure sensitive industrial tape with adhesive backing and Helvetica lettering. The lettering shall be applied with a Kroy high performance labeling machine or equal. Tape shall be clear with black lettering.

2.3 WIRE MARKERS

- A. Manufacturers:
 - 1. SETON
- B. Description: Cloth tape, split sleeve, or tubing type wire markers.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams and shop drawings.

2.4 CONDUIT AND RACEWAY MARKERS

- A. Manufacturers:
 - 1. SETON
- B. Description: Labels fastened with adhesive Stencils.
- C. Color:
 - 1. Medium Voltage System: Black lettering on Red background.
 - 2. 480 Volt System: Black lettering on white background.
 - 3. 208 Volt System: Black lettering on white background.
- D. Legend:
 - 1. Medium Voltage System: HIGH VOLTAGE.
 - 2. 480 Volt System: 480 VOLTS.
 - 3. 208 Volt System: 208 VOLTS.

2.5 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. SETON
- B. Description: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.6 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers: SETON

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 EXISTING WORK

- A. Install identification on existing equipment and conduits to remain in accordance with this section.
- B. Install identification on unmarked existing equipment and conduits.
- C. Replace lost nameplates, labels, and markers.
- D. Re-stencil existing equipment.

3.3 INSTALLATION

- A. Install identification devices in accordance with manufacturer's written instructions and requirements of the NEC.
- B. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- C. Install identifying devices after completion of painting.
- D. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners.
 - 4. Secure nameplate to equipment front using screws or, rivets.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Transformers.
 - d. Disconnects.
 - e. Lighting control panels.
 - f. Motor controllers.
- E. Label Installation:
 - 1. Install label parallel to equipment lines.
 - 2. Install label for identification of individual control device stations.
 - 3. Install labels for permanent adhesion and seal with clear lacquer.
- F. Wire Marker Installation:
 - 1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes manhole, handhole, and each load connection.
 - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 - 3. Install labels at data outlets identifying patch panel and port designation.
- G. Conduit Marker Installation:
 - 1. Install conduit marker for each conduit longer than 6 feet.

2. Conduit Marker Spacing: 20 feet on center.
 3. Raceway Painting: Identify conduit using field painting.
 - a. Paint each conduit longer than 6 feet.
 - b. Color:
 - 1) Fire Alarm System: Red.
 - 2) 480 Volt System: Dark Blue.
 - 3) 208 Volt System: Light Blue.
- H. Junction, Pull and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers which identify contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.
- I. Conductor Color Coding: Provide color coding for secondary service, feeder and branch circuit conductors throughout the project.
1. Use conductors with color factory-applied the entire length of the conductors except as follows:
 - a. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal point and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
- J. Tag or label conductors with vinyl film type wire markers as follows:
1. Multiple Circuits: Provide legend indicating source, voltage, circuit number and phase for branch circuit wiring. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
 2. Match identification markings with designations used in panelboards shop drawings, Contract Documents and similar previously established identification schemes for the facility's electrical installations.
- K. Apply warning, caution and instruction signs and stencils as follows:
1. Install warning, caution or instruction signs where required by NEC, where indicated or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
- L. Panel Schedules:
1. For panelboards, provide frames, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.
- M. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- N. Devices:
1. Provide labels on the face plate of each device indicating the branch circuit number. For special NEMA devices, also indicate the voltage, phase, and amperage.

O. COLOR CODING OF CONDUITS AND BOXES

1. Junction boxes shall be primed and painted with the following colors:

480/277V	Dark Blue
208/120V	Light Blue
Voice/Data/Communication	Yellow
Fire Alarm	Red

P. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 260553

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SECTION 260573 - ARC FLASH HAZARD ANALYSIS/SHORT-CIRCUIT COORDINATION STUDY

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SECTION 260573 - ARC FLASH HAZARD ANALYSIS/SHORT-CIRCUIT COORDINATION STUDY

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the Manufacturer's Engineering Services or approved equal.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002, the IEEE Guide for Performing Arc-Flash Calculations.
- C. The scope of the studies shall include all new distribution equipment. The coordination study shall be limited to the life safety and legally required branches of the emergency power distribution system.
- D. The Contractor shall make all required modifications to the equipment to accomplish conformance with the short circuit and protective device coordination studies. Modifications to the equipment shall be provided by the Contractor and all costs shall be included in this bid proposal. Modifications shall be provided by the Contractor at no additional cost to the Owner.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - 6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations

- B. American National Standards Institute (ANSI):
 - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 - 4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
 - 1. NFPA 70 -National Electrical Code, latest edition
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 SUBMITTALS FOR REVIEW/APPROVAL

- A. The studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

1.5 SUBMITTALS FOR CONSTRUCTION

- A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than five (5) copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Electronic PDF copies of the report shall be provided upon request.
- B. The report shall include the following sections:
 - 1. Executive Summary including Introduction, Scope of Work and Results/Recommendations.
 - 2. Short-Circuit Methodology Analysis Results and Recommendations
 - 3. Short-Circuit Device Evaluation Table
 - 4. Protective Device Coordination Methodology Analysis Results and Recommendations
 - 5. Protective Device Settings Table
 - 6. Time-Current Coordination Graphs and Recommendations
 - 7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
 - 8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
 - 9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

1.6 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be an employee of the equipment manufacturer or an approved engineering firm.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- D. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
- E. The engineering firm shall have a minimum of twenty-five (25) years experience in performing power system studies.

1.7 COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be performed using EASY Power for Windows software program.

PART 2 PRODUCTS

2.1 STUDIES

- A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies.

2.2 DATA

- A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT ANALYSIS

- A. Transformer design impedances shall be used when test impedances are not available.
- B. Provide the following:
 - 1. Calculation methods and assumptions
 - 2. Selected base per unit quantities
 - 3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
 - 4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
 - 5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
 - 6. Results, conclusions, and recommendations.
- C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.
- D. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short circuit ratings
 - 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.

2.4 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

- A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title with descriptive device names.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 - 1. Electric utility's overcurrent protective device
 - 2. Medium voltage equipment overcurrent relays
 - 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 - 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands

5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Medium voltage conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide the following:
1. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
 2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
 3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
 4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram
 5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices.

2.5 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04)
- B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E.
- D. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported

for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 5 cycles.
- H. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
- L. Provide the following:
 - 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
 - 2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.

PART 3 EXECUTION

3.1 FIELD ADJUSTMENT

- A. Contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- B. Contractor shall make all modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies at no additional cost to the Owner.

3.2 ARC FLASH LABELS

- A. The Contractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. The labels shall be designed according to the following standards:
 - 1. UL969 – Standard for Marking and Labeling Systems
 - 2. ANSI Z535.4 – Product Safety Signs and Labels
 - 3. NFPA 70 (National Electric Code) – Article 110.16
- C. The label shall include the following information:
 - 1. System Voltage
 - 2. Flash protection boundary
 - 3. Personal Protective Equipment category
 - 4. Arc Flash Incident energy value (cal/cm²)
 - 5. Limited, restricted, and prohibited Approach Boundaries
 - 6. Study report number and issue date
- D. Labels shall be printed by a thermal transfer type printer, with no field markings.
- E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
 - 1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
 - 2. Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
 - 3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

END OF SECTION 260573

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SECTION 262413 - LOW VOLTAGE SWITCHBOARDS

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SECTION 261116 - LOW VOLTAGE SWITCHBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes low voltage switchboards and accessories.
- B. Square-D has been selected as the Basis-of-Design achieving a smaller footprint to fit in allocated space. Substitutions will not be accepted.

1.3 REFERENCES

- A. Refer to individual product sections for applicable references.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate electrical characteristics and connection requirements, outline dimensions, connection and support points, weight, specified ratings and materials.
- B. Product Data: Submit electrical characteristics and connection requirements, standard model design tests, and options.
- C. Submit drawings specific to each product and accessory proposed. In addition, include the following information:
 - 1. Front view of enclosure with overall dimensions
 - 2. Single line diagram
 - 3. Top and bottom conduit entrance / exit locations with dimensions
 - 4. Electrical characteristics
 - 5. Specified ratings
 - 6. Bill-of-material
 - 7. Each type of overcurrent protective device
 - 8. Surge Protective Devices

9. Ground Fault Protectors
 10. Shipping splits and weights
 11. Wiring diagrams (if applicable)
 12. Operational instructions for keylock schemes, throw-over schemes, and other special instructions.
- D. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.
- E. Manufacturer's Field Reports: Indicate activities on site, final adjustments and overcurrent protective device coordination curves, adverse findings, and recommendations.
- F. Provide factory drawing of final assembly of all combined sections in the line-up, including overall dimensions, door swing clearances, and elevations. Submittals will not be reviewed without an overall dimensional drawing showing all sections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Include copy of manufacturer's certified drawings.
- B. Operation and Maintenance Data:
1. Submit instructions for manually and electrically opening and closing circuit breakers.
 2. Submit instructions for circuit breaker removal, replacement, testing and adjustment, and lubrication.
 3. Manufacturer, supplier, support, and repair center specific contact information.
 4. Manufacturer's standard operation and maintenance data assembled for each size and type of equipment furnished.
 5. All construction, installation, schematic, and wiring diagrams updated to an as-installed and commissioned state
 6. All configured settings/parameters for adjustable components updated to an as-installed and commissioned stated if different from the factory default. Electronic copies of configuration files shall be provided, on media acceptable to the Owner (e.g., CD, USB stick, etc.), where these configurations can be saved as an electronic file for future upload into replaced or repaired components.
 7. List of furnished and recommended spare parts.
 8. Statement of standard Warranty. [Statement of extended warranty options and costs.]
 9. Final Assembly and Testing Report
- C. Provide one (1) set of installation and maintenance instructions with each switchboard. Instructions are to be easily identified and affixed within the incoming or main section of the line-up.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

- B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.
- C. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9002 Series Standards for quality.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver individually wrapped for protection and mounted on shipping skids.
- B. Handle switchboard sections in accordance with NEMA PB 2.1.
- C. Lift only with lugs provided. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.
- D. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- E. Contractor is responsible for rigging the switchboards into the building and placing it in the final location. Verify all existing conditions and site constraints prior to ordering equipment. Modifications to switchboards that are required to rig the equipment into the building and setting in the final location is the responsibility of the Contractor.
- F. Deliver, store, protect, and handle products in conformance with manufacturer's recommended practices as outlined in applicable Installation and Maintenance Manuals.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Conform to specified service conditions during and after installation of switchboards.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 SEQUENCING

- A. Sequence work to avoid interferences with building finishes and installation of other products.

1.11 MAINTENANCE MATERIALS

- A. Furnish two each of special tools needed to operate and maintain switchboards.
- B. Furnish three of each key.

1.12 EXTRA MATERIALS

- A. Furnish three of each size and type fuse.

PART 2 PRODUCTS

2.1 SWITCHBOARDS

- A. Manufacturers:
 - 1. Square-D Type QED-2 (Basis of Design)
 - 2. The Square-D switchboards have been engineered by the factory to accommodate the existing conditions and room dimensions utilizing compact components. Contractor takes full responsibility for any deviations from the maximum dimensions shown on the drawing; including, but not limited to, relocation and modifications of all affected wiring, cabling, conduit, busducts, equipment, rigging path, interior walls, doors, ceilings, structural components, etc.
- B. Low voltage sections shall be designed for top/bottom and front cable access only on all sections (incoming and outgoing cables) to reduce width of equipment.
- C. Provide low voltage top hat cable pull box for termination of horizontal cable runs (There may not be adequate ceiling height to turn conduits down into the top of the switchgear). Contractor to provide field measurements to manufacturer prior to fabrication.
- D. Provide adequate ventilation to maintain temperature in pull box within same limits as switchboard. Set back from front to clear circuit breaker removal mechanism. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard. Lace cables using industry-approved methods.
- E. Provide warning signage on front covers.

2.2 SERVICE CONDITIONS

- A. Meet requirements for usual service conditions.
- B. Minimum Ambient Temperature: 22 degrees F
- C. Maximum Ambient Temperature: 104 degrees F
- D. Altitude: 3300 feet
- E. Load Current Harmonic Factor: 0.05 for each unit, maximum.

2.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code (NEC).
- B. ANSI/IEEE C12.16 - Solid-State Electricity Metering.
- C. ANSI C57.13 - Instrument Transformers.
- D. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
- E. NEMA PB 2 - Deadfront Distribution Switchboards, File E8681
- F. NEMA PB 2.1 - Proper Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- G. NEMA PB 2.2 - Application Guide for Ground Fault Protective Devices for Equipment.
- H. UL 50 - Cabinets and Boxes.
- I. UL 98 - Enclosed and Dead Front Switches.
- J. UL 489 - Molded Case Circuit Breakers.

- K. UL 891 - Dead-Front Switchboards.
- L. UL 943 - Standard for Ground Fault Circuit Interrupters.
- M. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.

2.4 GENERAL REQUIREMENTS

- A. The manufacture of the switchboard shall be the same as the manufacturer of the circuit breakers or the switches mounted in the switchboard.
- B. Provide steel barriers between switchboard sections.
- C. Provide hinged front covers.
- D. All new panelboards and switchboards on this project shall be by the same manufacture as the switchboard for the purposes of stocking common breaker types, series ratings, etc.
- E. Short Circuit Current Rating: Switchboards shall be rated with a minimum short circuit current rating as shown on the drawings.
- F. Future Provisions: All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- G. Enclosure: Type 1 - General Purpose.
- H. Sections shall be front aligned.
- I. Removable steel base channels (1.5 inch floor sills) shall be bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.
- J. The switchboard enclosure shall be painted on all exterior surfaces. The paint finish shall be a medium gray, ANSI #49, applied by the electro-deposition process over an iron phosphate pre-treatment.
- K. All front covers shall be screw removable with a single tool and all doors shall be hinged with removable hinge pins.
- L. Top and bottom conduit areas shall be clearly indicated on shop drawings.
- M. Nameplates: Provide 1 inch high x 3 inches engraved laminated (Gravoply) nameplates for each device. Furnish black letters on a white background for all voltages.
- N. Bus Composition: Shall be plated copper. Plating shall be applied continuously to all bus work. The switchboard bussing shall be of sufficient cross-sectional area to meet UL Standard 891 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown in the plans. For 4-wire systems, the neutral shall be of equivalent ampacity as the phase bus bar. Tapered bus is not acceptable. Full provisions for the addition of future sections shall be provided. Bussing shall include all necessary hardware to accommodate splicing for future additions.
- O. Bus Connections: Shall be bolted with Grade 5 bolts and conical spring washers.
- P. Ground Bus: Sized per NFPA70 and UL 891 Tables 25.1 and 25.2 and shall extend the entire length of the switchboard. Provisions for the addition of future sections shall be provided.
- Q. Accessibility: See drawings.

2.5 SWITCHBOARD – INCOMING MAIN SECTION DEVICES

- A. Circuit protective devices shall be two-step stored energy type circuit breaker.
- B. Main Circuit Breaker shall be electronic trip fixed mounted 100% rated circuit breaker. The case of the circuit breaker shall be a polyester thermoset material providing high dielectric strength.

- C. Circuit breaker trip system shall be a microprocessor-based true rms sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated.
- D. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
- E. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
- F. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and switch adjustments shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 100% of their ampere rating continuously when applied in the switchboards.
- G. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent from all other adjustments.
 - 1. Long Time Pickup & Long Time Delay
 - 2. Short Time Pickup & Short Time Delay (I^2t IN & I^2t OUT)
 - 3. Instantaneous Pickup
 - 4. Ground Fault Pickup & Ground Fault Delay (I^2t IN and I^2t OUT) – 480V
 - 5. Ground Fault Alarm Only Pickup – 208V
- H. A means to seal the rating plug and trip unit adjustments in accordance with NEC Section 240-6(b) shall be provided.
- I. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
- J. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in True rms with 2% accuracy.
- K. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
- L. The trip system shall include a Long Time memory circuit to protect against intermittent overcurrent conditions above the long time pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
- M. Circuit breaker trip system shall be equipped with an externally accessible test port for use with a Universal Test Set. Provide one (1) Universal Equipment Test Set for this project job for final inspection. This test set shall be suitable for testing all electric circuit breakers specified for this project. No disassembly of the circuit breaker is required for testing.
- N. True two-step stored energy mechanism with five (5) cycle closing time shall be provided. All circuit breakers shall have multiple CHARGE/CLOSE provisions allowing the following sequence:
- O. CHARGE, CLOSE, RECHARGE, OPEN/CLOSE/OPEN
- P. Local control pushbuttons to OPEN and CLOSE circuit breaker shall be provided. Color coded visual indication of contact position (OPEN or CLOSED) shall be provided on the face of the circuit breaker. Local manual charging following CLOSE operation shall be provided. Color coded visual indication of mechanism CHARGED and DISCHARGED position shall be provided on the face of the circuit breaker. Visual indicator shall indicate CHARGED only when closing springs are completely charged.

- Q. Each circuit breaker shall be electrically operated to permit remote CHARGE, CLOSE, and OPEN capabilities. Electrically operated circuit breaker shall be equipped with charge contact switch for remote indication of mechanism charge status.
- R. All circuit breakers shall be equipped with electrical accessories as noted as follows:
 - 1. Provide the following interlocking capabilities:
 - Lock off
- S. Equipment Ground Fault Protection – 480V
 - 1. Circuit breaker(s) shall be provided with integral equipment protection for grounded systems.
 - 2. The ground fault system shall be of the residual type.
- T. Terminations
 - 1. All lugs shall be UL Listed to accept solid and/or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating in the NEC.
 - 2. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs.
- U. Main circuit breaker shall be individually fixed mounted.
- V. Accessories: As indicated on the drawings.

2.6 SWITCHBOARD – DISTRIBUTION SECTION DEVICES

- A. Group mounted circuit breakers through 1200A
- B. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
- C. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
- D. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.
- E. Line-side circuit breaker connections are to be jaw type.
- F. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
- G. Electronic trip molded case full function 100% rated circuit breakers:
 - 1. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
 - 2. 480V Circuit breakers 1000A or greater shall be provided ground fault protection.
 - 3. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated schedule drawing.
 - 4. Local visual trip indication for overload, short circuit and ground fault trip occurrences.
 - 5. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

6. Communications capabilities for remote monitoring of circuit breaker trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings, and trip history information shall be provided.
 7. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.
 8. Accessories – As shown on the drawings.
- H. Electronic trip molded case standard function 80% rated circuit breakers:
1. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
 2. 480V Circuit breakers 1000A or greater shall be provided ground fault protection.
 3. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated [schedule] [drawing].
 4. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
 5. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.
 6. Accessories – As shown on the drawings.
- I. Thermal Magnetic Molded Case circuit breakers:
1. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
 2. Circuit protective devices shall be molded case circuit breaker(s). Circuit breaker(s) shall be standard interrupting high interrupting. Ampere ratings shall be as shown on the drawings.
 3. Accessories – As shown on the drawings.
- 2.7 MIMIC BUS
- A. Show the entire single line switchboard bus work, as depicted on the factory record drawing, on an engraved laminated plastic (Gravoply) nameplate. The nameplate shall be at least .0625 inch thick and located at eye level on the front cover of the switchboard incoming service section.
- 2.8 POWER METERING
- A. Provide a power meter for each application as shown on drawings & as follows:
- B. LV Mains: The metering device used to monitor the low voltage mains for network management, energy cost allocation, power quality analysis, asset management, operational efficiency, and compliance reporting, shall be as follows
1. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: PowerLogic PM5563 Meter by Schneider Electric
 2. I/O and Ethernet communications card.
- C. Metering Transformers:
1. Current Transformers: ANSI C57.13; 5 ampere secondary.
 2. Voltage Transformers: ANSI C57.13; 120 V single secondary

2.9 SECONDARY TRANSIENT VOLTAGE SUPPRESSION DEVICES

- A. Manufacturers: Square-D
- B. Product Description: IEEE C62.41, factory-mounted transient voltage surge suppressor, selected to meet requirements for high exposure and to coordinate with system circuit voltage.
- C. As shown on the drawings a TVSS unit shall be factory installed by the switchboard manufacturer on the load side of the main circuit breaker.
- D. TVSS shall be listed in accordance with UL 1449 Third Edition and UL 1283, Electromagnetic Interference Filters.
- E. TVSS shall be listed in accordance with UL 1449 Second Edition to include Section 37.3 highest Short Circuit Current Rating (SCCR) of 200 kA.
- F. TVSS shall be tested with the Category C3 high exposure waveform (20kV-1.2/50 μ s, 10kA-8/20 μ s) per ANSI/IEEE C62.41 - 1991.
- G. The manufacturer of the TVSS shall be the same as the manufacturer of the distribution equipment in which the devices are installed and shipped.
- H. TVSS shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.
- I. TVSS shall be modular in design. Each mode, including N-G, shall be fused with a 200 kAIR, UL recognized surge rated fuse and incorporate a thermal cutout device.
- J. The TVSS shall incorporate copper bus for the surge current path. Small gauge round wiring connections shall not be used in the path for surge current diversion. Surge current diversion modules shall use bolted connections to the copper bus for reliable low impedance connections.
- K. TVSS shall meet or exceed the following criteria:
1. Minimum surge current rating shall be 160 kA per phase
 2. UL 1449 clamping voltage must not exceed the following:
- | <u>VOLTAGE</u> | <u>L-N</u> | <u>L-G</u> | <u>N-G</u> | <u>L-L</u> |
|----------------|------------|------------|------------|------------|
| 480Y/277 | 1200V | 1200V | 1200V | 2000V |
| 208Y/120 | 800V | 800V | 800V | 1200V |
3. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE C62.41 Category C3 transients without failure or degradation of clamping voltage by more than 10 %.
- L. TVSS shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
- M. The TVSS surge capacity shall be 240KA as follows;
1. Line – Neutral 120KA, Line - Ground 120KA, Neutral – Ground 120KA
- N. Visible indication of proper TVSS connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each TVSS module shall be

monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator.

- O. TVSS shall be equipped with an audible alarm, which shall activate when any one of the surge current modules has failed. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
- P. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate a failure of a phase or the entire unit.
- Q. Terminals shall be provided for necessary power and ground connections.
- R. TVSS shall have a warranty for a period of five (5) years from date of invoice. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.10 MAINTENANCE MODE SWITCHES

- A. MAINTENANCE MODE ON-OFF switches shall be NEC 240.87 compliant. Switches shall be lockable with a local blue light to indicate that clearing time of overcurrent device has been reduced. Maintenance mode switches shall be provided for all circuit breakers equal to or greater than 1200A unless another means of reducing clearing time compliant to NEC 240.87 has been provided for that device. In addition, provide maintenance mode switches for circuit breakers as shown on drawings.
 - 1. Switches shall be an MMS or ERMS type switch. ERMS type switches shall be provided when circuit breakers are capable, otherwise furnish MMS switches.
 - 2. Energy Reduction Maintenance Switches (ERMS)
 - ERMS switches shall provide a clearing time of less than 50ms when activated.
 - Insulated case circuit breakers (ICCB) and Power Circuit Breakers provided with ERMS switches shall also be provided with a mobile smart device app (Android or iOS) that allows the circuit breaker to be put into maintenance mode from a distance (typically >33 feet line-of-sight).
 - 3. Maintenance Mode Setting (MMS) Switches shall provide a clearing time of less than 80ms when activated.

2.11 CONTROL POWER

- A. Control Circuits shall be 120 vac, supplied through secondary disconnecting devices from control power transformer. Primary and secondary control power fuses shall be provided for current limiting and overload protection of transformer and fuses for protection of control circuits.
- B. Control Wiring shall be installed, with bundling, lacing, and protection included. Flexible conductors shall be provided for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.12 MARKINGS AND LABELING

- A. All identification and warning labels and nameplates exterior to the switchboard shall be resistant to their intended installation environment.

- B. Each switchboard shall be provided with an engraved nameplate identifying the project specific equipment tag and service description
- C. Warning labels and nameplates shall be present at access locations to advise personnel of possible hazards. The SWBD shall be marked in accordance with UL, NFPA 70 NEC, NFPA 70E, and other applicable standards.
- D. A QR code on the front face of equipment shall provide access to unique digital record keeping or each switchboard furnished using a maintenance logbook application or website available on PC or smart mobile device. When scanned, the QR code shall provide access to the manufacturer's standard documentation plus unique documents for the furnished equipment such as serial number, as-built drawings, assembly and testing reports, device settings, spare part lists, etc. The logbook shall assist in compliance with NFPA 70B Article 31 and IEC 60634-6. Access shall be provided to the Owner with information protected by username and password.

2.13 FABRICATION

- A. Conform to requirements of ANSI C57.12.28.
- B. Construction: Indoor.
- C. Height: 90 inches, maximum, including auxiliary support members on top and bottom.

2.14 FACTORY FINISHES

- A. Clean surfaces before applying paint.
- B. Apply corrosion-resisting primer to surfaces.
- C. Finish Color: ANSI #49

2.15 SOURCE QUALITY CONTROL

- A. Provide factory tests to IEEE C57.12.90 and IEEE C57.12.91. Include routine tests as defined in IEEE C57.12.00 and ANSI C57.12.55 and the following other tests:
 - 1. Impedance voltage and load loss.
 - 2. Dielectric tests.
 - 3. Audible sound level.
 - 4. Short circuit capability.
 - 5. Telephone influence factor (TIF).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install switchgear plumb and level and with each section aligned properly.
- B. Make electrical connections between equipment sections using connectors furnished by manufacturer.

- C. Verify field measurements are as shown on drawings.
- D. Verify that required utilities are available, in proper location and ready for use.
- E. Beginning of installation means installer accepts conditions.
- F. Install in accordance with manufacturer's instructions.
- G. Install safety labels to NEMA 260.
- H. Provide new concrete equipment pads for all equipment. Pads shall be doweled to floor. Remove any existing pads and prepare surface for new pad.
- I. Provide insulating matting in front of all switchboards.

3.2 FIELD TESTING AND COMMISSIONING

- A. The Contractor shall inspect and test furnished equipment and associated systems for conformance to the contract documents, including equipment manufacture's recommendations, and readiness for operation.
- B. Visually inspect for physical damage and proper installation
- C. Perform tests in accordance with manufacturer's instructions
- D. Perform tests to ensure compliance with Contract Documents
- E. Perform tests that equipment is ready for operation
- F. Touch-up paint all chips and scratches with manufacturer-supplied paint and transfer remaining paint to Owner
- G. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
- H. Measure, using a Megger, the insulation resistance of each bus structure phase-to-phase and phase-to-ground for one minute each, at minimum test voltage of 1000 Vdc; minimum acceptable value for insulation resistance is 1 megohms. Refer to manufacturer's literature for specific testing procedures.
- I. Physically test key interlock systems to check for proper functionality prior to energizing.
- J. Test continuity of each circuit.
- K. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
- L. Contractor shall submit an operational readiness test report documenting all test results, including all assumptions, conditions, allowances and corrections made during the test. The report shall provide a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the equipment's O&M documentation. The test report shall include a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's

representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.

- M. Digital documentation of the final as-installed configuration of equipment including manuals, settings, parameters and test reports shall be provided by a maintenance logbook application or website available on PC or smart mobile device. The logbook shall assist in compliance with NFPA 70B Article 31 and IEC 60634-6 for commissioning and documentation of the configuration. Access to the digital documentation as well as the maintenance logbook application or website shall be provided to the Owner.

3.3 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Adjust circuit breaker trip and time delay settings to values as instructed by the Architect/Engineer as noted in the coordination study.
- D. Touch up scratched or marred surfaces to match original finish.

END OF SECTION 262413

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SECTION 262416 - PANELBOARDS

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SECTION 262416 - PANELBOARDS

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes distribution and branch circuit panelboards.

1.3 REFERENCES

- A. NEMA PB 1 - Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- E. UL 50 - Enclosures for Electrical Equipment
- F. UL 67 - Panelboards
- G. UL 98 - Enclosed and Dead-front Switches
- H. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- I. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
- J. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
- K. Federal Specification W-P-115C - Type I Class 1
- L. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.
- M. NFPA 70 - National Electrical Code (NEC)

N. ASTM - American Society of Testing Materials

1.4 SUBMITTALS

- A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.
- B. Product Data: Submit catalog data showing specified features of standard products.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum fifty years documented experience.

1.7 MAINTENANCE MATERIALS

- A. Furnish five of each panelboard key. Panelboards keyed alike.

PART 2 PRODUCTS

2.1 PANELBOARDS

- A. Manufacturers:
 - 1. Square-D Type NQ & NF (Basis of Design)
 - 2. Cutler-Hammer
 - 3. Siemens
 - 4. GE
- B. Interior
 - 1. Panelboard shall have continuous main current ratings, as indicated on associated schedules and drawings, not to exceed 600 amperes for main breaker panelboards and not to exceed 800 amperes for main lug panelboards.
 - 2. Minimum Short Circuit Rating: As indicated on the schedules and drawings.
 - 3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance

with UL 67. Bussing rated 100-400 amperes shall be plated copper. Bussing rated for 600 and 800 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.

4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
5. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided when indicated.
6. Split solid neutral shall be plated and located in the mains compartment up to 250 amperes so all incoming neutral cable may be of the same length. Provide CSA and UL Listed panelboards with 200% rated solid neutral for non-linear load applications when indicated. Panelboards shall be marked for non-linear load applications.
7. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have filler plates covering unused mounting space.
8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, CSA/UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
9. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 125A interiors shall be horizontally mounted. Main circuit breakers over 125A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.
10. Interior phase bus shall be pre-drilled to accommodate field installable options. (i.e., Sub-Feed Lugs, Sub-Feed Breakers, Thru-Feed Lugs)
11. Interiors shall accept 125 ampere breakers in group mounted branch construction.
12. Provide additional lugs to accommodate the oversized feeders.

C. Main Circuit Breaker

1. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.
2. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
3. Circuit breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be CSA and UL Listed for reverse connection without restrictive line or load markings.
4. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.

5. Lugs shall be CSA and UL Listed to accept solid or stranded copper conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.
 6. The circuit breakers shall be CSA and UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.
- D. Branch Circuit Breakers
1. Circuit breakers shall be CSA and UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the panelboard schedules and drawings.
 2. Molded case branch circuit breakers shall have bolt-on type bus connectors.
 3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
 4. There shall be two forms of visible trip indication. The circuit breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.
 5. The exposed faceplates of all branch circuit breakers shall be flush with one another.
 6. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16.
 7. Breakers shall be CSA and UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.
 8. Breaker shall be CSA and UL Listed with the following ratings: (15-125A) Heating, Air Conditioning, and Refrigeration (HACR), (15-30A) High Intensity Discharge (HID), (15-20A) Switch Duty (SWD), (15-50A) Equipment Protection Device (EPD) (480Y/277Vac maximum).
- E. Enclosures
1. Type 1 Boxes
 - a. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
 - b. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - c. Box width shall not exceed 20" wide.
 2. Type 1 Fronts
 - a. Front shall meet strength and rigidity requirements per UL 50 standards. Shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. Fronts shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated on associated schedules and drawings.
 - c. Panelboards rated 250 amperes and below shall have MONO-FLAT fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked.

Panelboards rated above 250 amperes shall have vented fronts with concealed door hinges. Doors on front shall have rounded corners; edges shall be free of burrs.

- d. Front shall have flat latch type lock with catch and spring loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

2.2 POWER PANELBOARDS

A. Manufacturers:

- 1. Square-D Type I-LINE (Basis of Design)
- 2. Cutler-Hammer
- 3. Siemens
- 4. GE

B. Panelboard Interior:

- 1. Continuous main current ratings as indicated on associated drawings not to exceed 1200 amperes maximum main lugs or main circuit breaker. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
- 2. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated drawings not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NFPA70 National Electric Code.
- 3. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
- 4. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated copper. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.
- 5. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
- 6. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided when indicated.
- 7. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter-mounted neutral will not be acceptable.
- 8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.

- C. Group mounted circuit breakers through 1200A
1. Circuit breaker(s) shall be group mounted with plug-on electrical connection, bolted to common pan or rail assembly.
 2. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
 3. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.
 4. Line-side circuit breaker connections are to be jaw type.
 5. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate breaker connectors and mounting hardware.
- D. Molded Case Circuit Breaker Characteristics - General
1. Circuit breakers shall be I-LINE - up to 1200 Amp maximum construction with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs. Circuit breakers connecting to oversized field wiring shall be UL Listed to accept field installable/removable mechanical type lugs. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating in the National Electrical Code.
 2. Circuit breaker/circuit breaker combinations for series connected interrupting ratings shall be listed by UL as recognized component combinations. Any series rated combination used shall be marked on the end use equipment along with the statement "Caution - Series Rated System. [] Amps Available. Identical Replacement Component Required".
 3. All circuit breakers with permanent trip units shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
- E. Surge Protective Device
1. Surge protection devices shall comply with Section 26 24 13.
 2. Surge protective devices shall be electrically connected to each phase bus of the panelboard, and should be installed close to the main incoming lugs or circuit breaker.
- F. Type 1 Boxes & Trim Fronts
1. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
 2. Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.
 3. Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.

4. Trim front shall be hinged 1-piece with door available in flush or[surface mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.
5. Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install panelboards and load centers in accordance with NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads. Schedules shall match as-built conditions.
- G. Install engraved plastic nameplates.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 1 empty 3/4 inch conduit for every (3) spares/poles. Identify each as SPARE.
- I. Provide painted sheet metal chase with removable cover from top of panel to above ceiling and from bottom of panel to floor to conceal wiring.
- J. Ground and bond panelboard enclosure. Connect equipment ground bars of panels in accordance with NFPA 70.

3.2 DELIVERY, STORAGE, AND HANDLING

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

3.3 WARRANTY

- A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of substantial completion.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.5 ADJUSTING

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
- B. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

END OF SECTION 262416

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SECTION 262716 - ELECTRICAL CABINETS AND ENCLOSURES

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SECTION 262716 - ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.
- B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

1.6 EXTRA MATERIALS

- A. Furnish five of each key.

PART 2 PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Reliance Electric
 - 4. Hoffman
 - 5. Square-D
 - 6. Siemens
 - 7. Cutler-Hammer
 - 8. Hammond
- B. Construction: NEMA 250, Type 1 steel enclosure.
- C. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
- D. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- E. Enclosure Finish: Manufacturer's standard enamel.

2.2 CABINETS

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Reliance Electric
 - 4. Hoffman
 - 5. Square-D
 - 6. Siemens
 - 7. Cutler-Hammer
 - 8. Hammond
- B. Boxes: Galvanized steel with removable end walls.
- C. Box Size: Per NEC angle and U-pull calculations.
- D. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- E. Knockouts: Provide as required.
- F. Furnish metal barriers to form separate compartments wiring of different systems and voltages.
- G. Furnish accessory feet for free-standing equipment.

2.3 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Reliance Electric
 - 4. Hoffman
 - 5. Square-D
 - 6. Siemens
 - 7. Cutler-Hammer
 - 8. Hammond
 - 9. IIsco
 - 10. Burndy
- B. Terminal Blocks: NEMA ICS 4.
- C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- E. Furnish ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.
- B. Install cabinet fronts plumb.

3.2 CLEANING

- A. Clean electrical parts to remove conductive and harmful materials.
- B. Remove dirt and debris from enclosure.
- C. Clean finishes and touch up damage.

END OF SECTION 262716

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SECTION 262726 - WIRING DEVICES

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SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; multi-outlet assembly; and device plates and decorative box covers.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 EXTRA MATERIALS

- A. Furnish two of each style, size, and finish wall plate.

PART 2 PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers:
 - 1. Cooper Wiring Devices.
 - 2. Hubbell, Inc.
 - 3. Leviton Manufacturing Company.
 - 4. Legrand (Pass & Seymour)
- B. Product Description: NEMA WD 1, Extra Heavy-Duty, AC only general-use snap switch.
- C. Body and Handle: Toggle with silver-cadmium contacts and one-piece copper alloy contact arm.
- D. Indicator Light: Lighted handle type switch.
- E. Locator Light: Lighted handle type switch; red color handle.
- F. Ratings:
 - 1. Voltage: 120-277 volts, AC.
 - 2. Current: 20 amperes.
- G. Color: As selected by Architect.

2.2 WALL DIMMERS

- A. As specified on the drawing.

2.3 RECEPTACLES

- A. Manufacturers:
 - 1. Cooper Wiring Devices.
 - 2. Hubbell, Inc.
 - 3. Leviton Manufacturing Company.
 - 4. Legrand (Pass & Seymour)
- B. Product Description: NEMA WD 1, Tamper-Resistant Heavy-duty grade general use receptacle.
- C. Device Body:
 - 1. Architecturally Finished Areas: Decorator Style.
 - 2. Non-Finished or Concealed Areas: Standard Duplex.
 - 3. Isolated ground where shown.
- D. Device Color: As selected by Architect. (Receptacles connected to emergency power shall have orange or red device body as selected by Owner).
- E. Configuration: NEMA WD 6, type.
- F. Convenience Receptacle: Type 5-20R.

- G. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. Self-testing, weather-resistant.
- H. USB Charger Receptacle:
 - 1. Heavy-Duty Decorator Specification Grade
 - 2. 125V., 20 Amp
 - 3. (1) USB C / (1) USB A
 - 4. Tamper Resistant
 - 5. Overall 6A charging capability
 - 6. Legrand TR20USBACxx
- I. Duplex receptacles (wireless RF dual switch) - Lutron #CAR2S-20-DTR-color by architect.
- J. Duplex receptacles (wireless RF half switch) - Lutron #CAR2S-20-STR-color by architect.

2.4 WALL PLATES

- A. Manufacturers:
 - 1. Cooper Wiring Devices.
 - 2. Hubbell, Inc.
 - 3. Leviton Manufacturing Company.
 - 4. Legrand (Pass & Seymour)
- B. Decorative Cover Plate: Brushed 302 stainless steel.
- C. Jumbo Cover Plate: Brushed 302 stainless steel.
- D. Lighting Control Devices: Custom color as selected by Architect.
- E. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover.

2.5 TIMER SWITCHES

- A. Not applicable

PART 3 EXECUTION

3.1 EXAMINATION

- A. This Contractor shall examine all architectural drawings and details before locating outlets. Outlets shall be placed as required to harmonize with moldings, panels, etc. Outlet locations shall not be obtained from scale dimensions on electrical drawings but from measurements on architectural plans and/or details.
- B. If an outlet is installed by this Contractor in such a location as to be out of proper relation to beams, walls, or other details of the building, its location shall be corrected by, and at the expense of this Contractor, at the direction of the Design Professional.
- C. Verify outlet boxes are installed at proper height.

- D. Verify wall openings are neatly cut and completely covered by wall plates.
- E. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Provide for each device indicated, a box suited to the purpose for which the device is to be put and to the location in which it occurs.
- B. Do not install device boxes back-to-back.
- C. Coordinate with Design Professional prior to installation for all device mounting heights.
- D. Secure electrical devices firmly in place within boxes, setting devices straight and true with box sides and mounting surface.
- E. Install face plate straight and true with mounting surface.
 - 1. Gaps between back of plate and mounting surface are not permitted.
 - 2. Set face plate mounting screws with slots in vertical direction.
- F. All backboxes recessed in concrete in CMU masonry walls shall sit flush with face of wall. Provide boxes with proper depth and/or extension ring.
- G. Wiring devices to be furnished and installed by this Contractor shall consist of the various types of wall switches, receptacles, outlets, and plates as required for the Electrical Work. The extent of the wiring devices shall be shown on the drawings.
- H. Local wall switches near doors shall be located on the strike side of doors as finally hung, whether or not so indicated on the Plans. If, because of the construction, it is not practical to mount on the strike side, these locations shall be brought to the Design Professional's attention, and meet his approval before roughing in.
- I. Single pole switches shall switch the ungrounded wire of circuits. Neutral wire shall not run through switches provided with a neutral shunt or bridge.
- J. Switches shall be mounted with the long dimensions vertical.
- K. All receptacles and communication outlets located next to each other shall be mounted 8" apart (horizontally) center to center.
- L. All switches located adjacent to each other shall be ganged under single multi-gang cover plate.
- M. Install devices plumb and level.
- N. Install switches with OFF position down.

- O. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- P. Do not share neutral conductor on load side of dimmers.
- Q. Install receptacles with grounding pole on bottom.
- R. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- S. Install wall plates on flush mounted switches, receptacles, and blank outlets.
- T. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- U. Connect wiring devices by wrapping solid conductor around screw terminal.
- V. Use jumbo size plates for outlets installed in masonry walls.
- W. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install wall switch 48 inches above finished floor.
- B. Install convenience receptacle 18 inches above finished floor.
- C. Install convenience receptacle 6 inches above back splash of counter.
- D. Install dimmer 48 inches above finished floor.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 262726

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SECTION 262819 - ENCLOSED SWITCHES

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SECTION 262819 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes fusible and non-fusible switches.

1.3 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.4 SUBMITTALS

- A. Product Data: Submit switch ratings and enclosure dimensions.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Square-D
 - 2. Cutler-Hammer
 - 3. Siemens
 - 4. ABB/GE
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses, unless other fuse type is shown on the drawings
- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Industrial Locations: Type 4X
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.
- G. All switches shall be provided with viewing window.

2.2 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Square-D
 - 2. Cutler-Hammer
 - 3. Siemens
 - 4. ABB/GE
- B. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from [steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Industrial Locations: Type 4X

- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.
- F. Provide auxiliary contacts for all switches associated with the Smoke Control System.
- G. Provide auxiliary contacts for all switches located between the motor and VFD. Contacts shall open prior to switch blades to presignal VFD shut down prior to disconnecting power. Provide control wiring between switch and VFD.
- H. Elevator Switches: Provide fuse type recommended by the elevator manufacturer. Each disconnect shall have an auxiliary contact that opens when the disconnect is opened. Provide 2 sets of 600V., 2/C #18 wire from each disconnect to the elevator controller.
- I. All switches shall be provided with viewing window.

2.3 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
- B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Height: 5 feet to operating handle.
- B. Install fuses for fusible disconnect switches.
- C. Install engraved plastic nameplates in accordance with Section 26 05 53.
- D. Apply adhesive tag on outside of door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 262819

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SECTION 265000 - LED LIGHTING

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SECTION 265000 - LED LIGHTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 SUMMARY

- A. Section includes interior luminaires, LED modules, drivers, power supplies, and accessories.
- B. Reference Specification and Drawings for fixture schedule and other requirements.

1.3 SCOPE OF WORK

- A. Provide and install a complete system of lighting fixtures installed in place, including LED modules, wired and connected and left in a satisfactory operating condition. At time of final approval by the Design Professional all fixtures shall be clean and any defective modules, power supplies or drivers replaced at no additional charge.
- B. Contractor shall furnish and install a complete and fully working lighting system with all necessary components, accessories, drivers, power supplies, etc. in accordance with the manufacturer's recommendations to meet the specifications and design intent herein. It is the responsibility of the Contractor to ensure all necessary equipment, specialties, and appurtenances are included regardless of the product specification.
- C. Contractor shall be responsible for verifying mounting compatibility and plenum clearance of all lighting fixtures and shall notify the Design Professional of any conflicts with structure, HVAC or plumbing prior to the ordering of the equipment in question. Any conflict will be verified in field with the Design Professional.
- D. The work to be done under this project includes providing all equipment materials, labor and services, and performing all operations for a complete and operating system. Any work not specifically covered but necessary to complete this installation shall be provided. All equipment and wiring to be new and provided under this contract unless otherwise noted.
- E. The Contractor shall perform all cutting and patching of existing masonry construction required by this work. All backboxes, conduit, and wiring shall be concealed in the existing construction unless otherwise noted.

- F. The Contractor shall coordinate the lighting fixture installation with all other trades.
- G. Upon completion of work, the Contractor shall clean light fixtures and lenses. Equipment shall be adjusted to direction by Design Professional. All systems shall be tested to satisfaction of Owner.
- H. Contractor shall be responsible for final targeting of light fixtures under the observation, and according to the recommendations of the Design Professional. Aiming shall take place after dark at a mutually agreed upon time. All costs associated with this effort shall be included in the base bid. Aiming must take place after the project's amenities have been installed. Amenities shall include but not necessarily be limited to plantings, furniture, artwork, graphics, and signage. Contractor shall include in the base bid, provisions for lifts, scaffolding, ladders, and other materials required to complete these adjustments.
- I. For each product and/or system, the Design Professional will review (1) original shop drawing submission and (1) resubmission of the same product and/or system. The Design Professional will charge the Contractor \$275.00 per hour for subsequent reviews.
- J. Any substitutions for the specified products on the lighting fixture schedule may result in an adverse change in the intended performance of the lighting fixture or lighting control.
- K. The contract drawings and Basis-of-Design specifications establish the "Minimum Standard of Quality" each product and/or system must meet to be considered acceptable. Products of other manufacturers will be considered, prior to submission of bid, if the product and/or system meets or exceeds the "Minimum Standard of Quality" established by the Design Professional.
- L. Approval of unspecified products and/or systems may be obtained by the Contractor who submits written requests at least seven days before the bids are due. Requests after this date will not be considered. It shall be the responsibility of the Contractor requesting the approval of unspecified products and/or systems to prove equality. This statement of proof shall include a line-by-line, item-by-item description of the specified and proposed product and/or system. The request must clearly describe each item for which the approval is requested, including (3) originals (photocopies will not be accepted) of data sheets, manufacturer's name, product name, product order number, complete specifications, descriptive data, test reports, cost savings (per fixture), and a written guarantee by the Contractor that the submitted products and/or systems comply with the specifications in all respects, and if not, will be replaced at his expense with the specified item. In addition, the Contractor shall provide electronic lighting calculations indicating illuminance levels, all data pertaining to the space model and reflectances, and the IES files for each fixture.
- M. The Design Professional will review the complete submission for compliance with the contract documents. If in the opinion of the Design Professional the product and/or system is acceptable as an equal as herein described, an addendum will be issued. The acceptance will not, in any way, relieve the Contractor or his supplier/vendor from full compliance with the contract documents.

1.4 REFERENCES

- A. ANSI/IES RP-16-10: Nomenclature and Definitions for Illuminating Engineering
- B. ANSI C78.377: Specifications for the Chromaticity of Solid State Lighting Products
- C. IEEE PAR1789: A Review of the Literature on Light Flicker: Ergonomics, Biological Attributes, Potential Health Effects, and Methods in Which Some LED Lighting May Introduce Flicker

- D. IES LM-79-08: Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
- E. IES LM-80-08: Approved Method: Measuring Lumen Maintenance of LED Light Sources
- F. IES TM-21-01: Projecting Long Term Lumen Maintenance of LED Light Sources
- G. NEMA SSL-1: Electric Drivers for LED Devices, Arrays, or Systems
- H. NEMA SSL-3: High-Power White LED Binning for General Illumination
- I. NEMS SSL-6: Solid State Lighting for Incandescent Replacement – Dimming

1.5 SUBMITTALS

- A. SHOP DRAWINGS: Submit manufacturer's product data on each fixture, power supply, and driver. See Fixture Schedule Notes for other requirements.
- B. Fixture data shall include photometric test data and full catalog number indicating all accessories.
- C. Contractor shall submit to the Design Professional for review, photographs and specifications that may be required by the Engineer. The submission shall include all fixture types bound in one portfolio.
- D. The Contractor, upon award of contract, shall immediately assemble the lighting fixture submittal package and fully coordinate purchase of fixtures with the delivery time for each fixture. The delivery time for each fixture shall be clearly noted on the shop drawings.
- E. The Contractor shall include in his construction schedule, the possible rejection of shop drawings and shall be responsible for project delays associated with his failure to submit accurate and complete shop drawings.
- F. The Contractor shall pay all fees required by manufacturer and Design Professional for the possible expediting of fixture deliveries.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.7 MOCK-UP

- A. Provide luminaires in ceiling assembly mock-up.
- B. Locate where directed by Design Professional.
- C. Incorporate accepted mockup as part of Work.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 MAINTENANCE MATERIALS

- A. Furnish five of each plastic lens type.
- B. The Contractor shall furnish to the Owner at the completion of the project, a minimum of 5% (minimum of 2) spare LED driver and power supply assemblies for each fixture type. LED drivers and power supplies shall be turned over to the Owner representative in their manufacturer's protective packaging. LED drivers and power supplies not in their protective packaging will not be acceptable.
- C. The Contractor shall furnish to the Owner at the completion of the project, a minimum of 5% (minimum of 2) spare LED light engine assemblies for each fixture type. LED light engines shall be turned over to the Owner representative in their manufacturer's protective package.

1.10 WARRANTY

- A. This Contractor shall deliver the work described herein in a first class operating condition in every respect. This Contractor shall also warrant that the material and workmanship shall be entirely free from defects for a period of one year after the certificate substantial completion. Any materials, equipment, or workmanship in which defects may develop before or during the warranty period shall be repaired or replaced at the Contractors own expense. The contractor shall further warrant that all material, equipment, and workmanship used in the installation, but not specifically mentioned in the Drawings and Specifications, is the best of their respective kinds and that the construction and installation was performed in accordance with the best accepted standard practices in all details.
- B. All luminaires shall have a minimum five (5) year factory warranty for defective or non-starting power supply units (driver), and LED source assemblies, which includes, but not limited to: LED package, LED arrays, LED modules, LED die, encapsulate, and phosphor.

1.11 PERFROMANCE REQUIREMENTS

- A. Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting inside building larger than 5000 square feet. Control shutoff by method conforming to ICC IECC.
- B. Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting outside building. Control shutoff by method conforming to ICC IECC.

1.12 SUBMITTALS

- A. Product Data: Required.
- B. Samples: Required.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Manufacturers:
 - 1. As Scheduled.

2. Substitutions: None

- B. Product Description: Complete luminaire assemblies, with features, options, and accessories as indicated on Drawings.
- C. Minimum Efficacy, Lamps Greater Than 100 Watts: 60 lumens/W, except where otherwise indicated or permitted by applicable code.
- D. All fixtures shall comply with the standards of ETL and RLM and shall bear the National Board of Fire Underwriters label. Each fixture shall bear an I.B.E.W. label.
- E. Lighting fixtures shall be of type and manufacturer as described in the lighting fixture schedule on the electrical drawings. Finish and color shall be as selected by the Architect.
- F. Lighting fixtures listed on fixture schedule are series, type and modular size only. This Contractor shall be responsible to provide the proper accessories for proper installation of the fixture (i.e., plaster frame, canopies, pendant stems, aircraft cable, etc.).

2.2 EXIT SIGNS

- A. Manufacturers:
 - 1. As scheduled.
- B. Product Description: Complete LED luminaire assemblies, with features, options, and accessories as indicated on Drawings.
- C. Product Description: Exit sign fixture.
- D. Face: Translucent face with red letters on white background, unless otherwise scheduled.
- E. Input Voltage: 120/277 volts.
- F. Lamps: 5 W per side, maximum.

2.3 LED FIXTURES, DRIVERS, AND POWER SUPPLIES

- A. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
- B. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
- C. LED drivers shall include the following features unless otherwise indicated:
 - 1. Minimum efficiency: 85% at full load.
 - 2. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
 - 3. Input Voltage: 120 - 277V (±10%) at 60 Hz.
 - 4. Integral short circuit, open circuit, and overload protection.
 - 5. Power Factor: ≥ 0.95.

6. Total Harmonic Distortion: $\leq 20\%$.
 7. Comply with FCC 47 CFR Part 15.
- D. LED modules shall include the following features unless otherwise indicated:
1. Comply with IES LM-79 and LM-80 requirements.
 2. Minimum CRI 80 and color temperature 3000° K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
 3. Minimum Rated Life: 50,000 hours per IES L70.
 4. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
- E. Housing, LED driver, and LED module shall be products of the same manufacturer.
- F. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
- G. Luminaires
1. The luminaire manufacturer shall provide the manufacturer's name of the LED being used in the luminaire.
 2. Shall be UL, or ETL, listed and be furnished complete with LEDs and power supplies.
- H. LED light source packages, arrays or modules used in the luminaire shall be tested in accordance with LM-80 lumen depreciation test. Provide to the University, test results of each unique package, array or module. The L70 rated life result shall be a minimum of 50,000 hours.
- I. Each luminaire shall have a power factor $\geq 90\%$.
- J. In instances where the LED sources are to be mounted directly into the architecture, such as installing a strip LED by using an adhesive tape, the LED manufacturer shall provide a recommended heat sink volume adequate to achieve rated life.
- K. Each luminaire shall carry a 5 year minimum product warranty covering failure of ALL electrical components.
- L. Power Supplies
1. LED power supplies shall operate LEDs within the current limit specification of the manufacturer
 2. Shall operate from 60Hz input source and have input power factor $>90\%$ and a minimum efficiency of 70% at full rated load of the driver.
 3. Shall have short circuit and overload protection.
 4. Shall have a minimum starting temperature of 0°F and a maximum case temperature rating of at least 70°C.
 5. Power supply output shall be regulated to $\pm 5\%$ across published load range.

2.4 GENERATOR TRANSFER DEVICE (FIXTURE MOUNTED)

- A. Generator-supplied egress lighting shall be provided by using a standard fixture equipped with a Bodine GTD generator transfer device. The device shall be capable of bypassing the wall switch when the auxiliary generator (or central inverter system) powers lighting. The device shall consist of relay switching circuitry and fusing contained in one 8" x 1.18" x 1.18" galvanized steel case; shall operate at 120 or 277 VAC, 60 Hz; shall have all inputs fused to 3A maximum; shall draw 280 mA and 1.6 watts during normal operation; and shall comply with the current NEC. The device shall be UL listed for installation inside, on top of or remote from the fixture and shall be warranted for a full five years from date of purchase.

2.5 GENERATOR TRANSFER DEVICE (REMOTE 20A)

- A. Emergency egress lighting shall be provided by using lighting loads equipped with a Bodine GTD20A emergency lighting relay control device. The device shall be capable of bypassing the local switching means when normal utility power has been lost. The device shall consist of relay switching circuitry, a test switch, a normal power indicator light and an alternate power indicator light contained in one 9" x 6" x 3.5" enclosure; shall sense normal power at 120 through 277 VAC, 50/60 Hz; shall be rated for 120 277 VAC, 50/60 Hz at up to 20 amps of lighting load; shall draw 45 mA and 4.0 watts during normal sensing operation; and shall comply with the current NEC. The device shall be UL listed for field installation in indoor or damp locations and shall be warranted for a full five years from date of purchase.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All fixtures shall be erected and shall hang perfectly plumb with canopies set squarely against the wall or ceiling. They shall be completely wired with wires of the same grade and insulation as specified for lighting circuit work with all splices using spring type solderless connectors according to NEC rules.
- B. CONTRACTOR shall check the type of ceiling where recessed fixtures are installed to be sure the proper type of mounting hardware is ordered and to determine if a lay-in type fixture or otherwise is required or if plaster rings are required. He shall be responsible to see that the proper type fixture is installed to suite the ceiling condition and mounting depth.
- C. Reflectors, reflector cones and visible trim of all lighting fixtures shall not be installed until completion of plastering, ceiling tile work, painting and general clean-up. They shall be carefully handled to avoid scratching or fingerprinting and shall be, at the time of acceptance by OWNER, completely clean.
- D. Fixture housing and door frames shall be fully sealed against light leakage. Light leaks between ceiling trims of recessed lighting equipment and the ceilings will not be permitted. Recessed fixture openings cut into the general construction shall not be larger than the fixtures trim ring. Contractor shall be responsible for all fixture cutting and patching.
- E. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- F. Support luminaires independent of ceiling framing.

- G. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- H. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- I. Exposed Grid Ceilings: Install auxiliary members spanning ceiling grid members to support surface mounted luminaires.
- J. Install recessed luminaires to permit removal from below.
- K. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- L. Install clips to secure recessed grid-supported luminaires in place.
- M. Install wall-mounted luminaires at height as indicated on Drawings.
- N. Install accessories furnished with each luminaire.
- O. Connect luminaires to branch circuit using flexible conduit.
- P. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- Q. Ground and bond interior luminaires.
- R. Provide TenMat fire rated covers for all fixtures in rated ceilings, exterior soffits, and acoustically sensitive rooms.

3.2 FIELD QUALITY CONTROL

- A. Replace defective drivers, power supplies, and LED modules for a period of one year following the Date of Substantial Completion.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING AND CLEANING

- A. Clean interior of lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses, louvers, and cones. If fingerprints and smudges cannot be cleaned, the lenses, louvers, and cones shall be replaced with new.
- B. Protect installed fixtures from damage during remainder of construction period.
- C. Aim and adjust luminaires as indicated on Drawings.

3.4 CLEANING

- A. Remove dirt and debris from enclosures.

- B. Clean photometric control surfaces as recommended by manufacturer.
- C. Clean finishes and touch up damage.

3.5 GROUNDING

- A. Provide equipment grounding connections for interior lighting fixtures as indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

3.6 DEMONSTRATION

- A. Upon completion of installation of interior lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units and proceed with retesting.

END OF SECTION 265000

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SECTION 268000 - FIRE DETECTION AND ALARM

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SECTION 268000 – FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 RELATED DOCUMENTS AND SECTIONS

- A. Drawings and applicable sections of Division 00 – Procurement and Contracting Requirements and Division 01 – General Requirements shall govern the work of this contract unless otherwise specified herein and all requirements shall be completely fulfilled to the satisfaction of the Design Professional and Owner.
- B. All specification sections of Division 07 – Thermal and Moisture Protection, Division 21 – Fire Suppression, Division 22 – Plumbing, Division 23 – Heating, Ventilating, and Air Conditioning (HVAC), Division 25 - Direct Digital Control Systems for HVAC, Division 26 – Electrical and drawings are made part of this contract and shall apply to all work described in this Section.

1.2 REFERENCES

- 1. 2018 NFPA 1 - FIRE CODE - EXCEPT WHERE SUPERSEDED BY UFC 3-600-01 FIRE PROTECTION
- 2. 2018 NFPA 101 - LIFE SAFETY CODE - EXCEPT WHERE SUPERSEDED BY UFC 3-600-01 FIRE PROTECTION
- 3. 2016 NFPA 72 - FIRE ALARM CODE - EXCEPT AS MODIFIED BY UFC 3-600-01 FIRE PROTECTION
- 4. 2020 US ARMY GARRISON, WEST POINT, NY ENGINEERING PLANNING STANDARDS - LATEST EDITION
- 5. NFPA 92A - Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences 2006 Edition.
- 6. NFPA 92B - Standard for Smoke Management Systems in Malls, Atria, and Large Spaces 2005 Edition.
- 7. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- 8. NFPA 70 National Electrical Code
- 9. NFPA 90A Standard for The Installation of Air Conditioning and Ventilating Systems
- 10. NFPA 101 Life Safety Code
- 11. FM Global (Factory Mutual (FM)):FM Approval Guide
- 12. UL Fire Protection Equipment Directory
- 13. UL Electrical Construction Materials Directory
- 14. UL 38 – Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
- 15. UL 228 – Door Holding Devices
- 16. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
- 17. UL 268A - Smoke Detectors for Duct Application
- 18. UL 464 - Audible Signal Appliances
- 19. UL 497A – Secondary Protectors for Communications Circuits
- 20. UL 521 - Heat Detectors for Fire Protective Signaling Systems
- 21. UL 864 - Control Units for Fire Protective Signaling Systems
- 22. UL 1076 – Security
- 23. UL 1283 – Electromagnetic Interference Filters
- 24. UL 1449 - Transient Voltage Surge Suppressors
- 25. UL 1480 - Speakers for Fire Protective Signaling Systems
- 26. UL 1971 - Signaling Devices for the Hearing Impaired
- 27. State and Local Building Codes as adopted and/or amended by The Authority Having Jurisdiction, ADA, and/or State and local equivalency standards as adopted by The Authority Having Jurisdiction.
- 28. Equipment and labor not specifically referred to herein or on the plans, but which are required by the codes and standards, shall be provided without additional cost to the Owner.

1.3 SCHEDULES

- A. Provide a schedule of the work indicating the following:
 - 1. Intended sequence of work items.
 - 2. Start dates of individual work items.
 - 3. Duration of individual work items.
 - 4. Planned delivery dates for major materials and equipment and expected lead times.
 - 5. Milestones indicating possible restraints on work by other trades or situations.
 - 6. Provide weekly written status reports indicating work completed and revisions to expected delivery dates. Include an updated project schedule and number of workers on the project.

1.4 DEFINITIONS

- A. ASME: American Society of Mechanical Engineers
- B. FACP: Fire alarm control panel.
- C. FM: FM Global (Factory Mutual)
- D. Furnish: To supply the stated equipment or materials.
- E. Install: To set in position and connect or adjust for use.
- F. LED: Light-emitting diode.
- G. NCC: Network Command Center
- H. NFPA: National Fire Protection Association. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- I. NICET: National Institute for Certification in Engineering Technologies.
- J. Provide: To furnish and install the stated equipment or materials.
- K. UL: Underwriters Laboratories

1.5 SUMMARY

- A. This specification describes an expansion of the existing addressable Fire Detection and Alarm system.
- B. The features and capacities described in this specification are required as a minimum for this project and shall be furnished by the successful contractor.
- C. All points monitored and controlled by a single node shall be capable of being programmed as "Public". Each point made public to the network may be programmed to be operated by any other node connected to the network.
- D. The Contractor shall give all necessary notices, obtain all permits, and pay all governmental taxes, fees, deposits, and other costs in connection with his work. He shall file all necessary plans, prepare all documents, and obtain all required Certificates of Inspection and Approval for his work, including those for occupancy.
- E. The Contractor shall include in his work, without extra cost to the Owner, any labor, materials, services, apparatus, drawings, in addition to Contract Documents, in order to meet the functional intent and comply with all applicable Codes, Laws, Ordinances, Rules and Regulations, whether or not indicated in the Construction Documents.

- F. Fire Alarm System: NFPA 72, manual and automatic local fire alarm system with connections to central station and Owner's remote monitoring system.
- G. The system shall include all required hardware, raceways, interconnecting wiring and software to accomplish the requirements of this specification and the contract drawings, whether or not specifically itemized herein.
- H. All equipment furnished shall be new and the latest state of the art products of a single manufacturer, engaged in the manufacturing and sale of analog fire detection devices for over ten years.
- I. The system as specified shall be supplied, installed, tested and approved by the local Authority Having Jurisdiction, and turned over to the owner in an operational condition.
- J. In the interest of job coordination and responsibilities the installing contractor shall contract with a single supplier for fire alarm equipment, engineering, programming, inspection and tests.
- K. General Requirements:
 - 1. The system shall be in full compliance with National and Local Codes.
 - 2. Elevator Lobby and Machine Room smoke detectors shall initiate elevator recall to the primary or alternate floor by removing the elevators from control of the public and placing them under the control of the Fire Department.
 - 3. Provide heat and smoke detectors in the elevator hoistway.
 - 4. Fire alarm wiring to be Class A per Owner's specifications.
 - 5. All visual notification devices to be wall mounted.
 - 6. Manual fire alarm boxes (pull stations) not more than 5 feet from entrance to each exit. The height of the pull stations shall be a minimum of 44" and a maximum of 48", measured vertically, from the floor level to the activating handle. Reference drawings for mounting height requirements for existing and new devices. All existing devices shall be lowered to match new installation heights and to comply with ADA accessibility requirements.
 - 7. All sprinkler system tamper switches, flow switches, and pressure switches, and fire pump (If installed) shall be monitored by the fire alarm system. Quantities are not shown on the drawings. Coordinate with the Fire Protection Contractor for exact quantity and location prior to submitting bid.
 - 8. Provide audible alarms in all areas of the building. The audible alarm notification devices shall provide a sound pressure level of 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, in every space within the building. Minimum sound pressure level shall be 70 dBA, except for Mechanical Equipment Rooms which shall be minimum 90 dBA and student units which shall be minimum 75dBA above ambient at bed pillow with all doors closed and all HVAC equipment running.
 - 9. Provide visible alarm notification appliances (strobes) in the following areas and where shown on the drawings:
 - a. Public and common areas
 - b. Employee work areas
 - c. Each Toilet Room

- d. Common corridors
 - e. Equipment Rooms
 - f. Meeting / Conference Rooms
 - g. Classrooms
 - h. Laboratory Spaces
 - i. Music Rooms
10. Provide Horn/Strobes throughout the renovated spaces.
 11. Provide additional notification appliance circuit power supplies as required.
 12. Smoke detectors to be provided throughout the renovated space as shown on the drawings.
 13. Duct mounted smoke detectors to be located in all supply and return air ductwork.
 14. The system will be networkable.
 15. NAC panels shall be provided to power the notification devices.
 16. Magnetic door holders and associated smoke detectors shall be provided where shown. Coordinate door holder with the Architect.
 17. Batteries shall be sized for 15 minutes of alarm at full load after 24 hours of system standby.
 18. Provide interface to the audio, sound, and video systems to mute the speakers.
 19. Fire alarm system shall release all security system secured doors. Provide all interface devices and wiring.

1.6 SYSTEM DESCRIPTION

- A. The system shall be a complete, electrically supervised fire detection and notification system, with devices that are UL listed and compatible with the existing system.
- B. 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. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.
 3. A maintenance and testing service shall be provided.
- C. Audible Alarm Notification: By tone signals on horns in areas as indicated on drawings.
- D. 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.

3. Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device is in alarm on the initiating zone.

E. Power Requirements

1. The control unit shall receive AC power via a dedicated fused disconnect circuit.
2. The 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 15 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. 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.
4. 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.
5. 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.

1.7 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Complete manufacturer's catalog data including supervisory power usage, alarm power usage, physical dimensions, and finish and mounting requirements.
- B. Power calculations. Battery capacity calculations. Battery size shall be a minimum of 125% of the calculated requirement. Provide the following supporting information:
 1. Supervisory power requirements for all equipment.
 2. Alarm power requirements for all equipment.
 3. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity.
 4. Voltage drop calculations for wiring runs demonstrating worst-case condition.
 5. NAC circuit design shall incorporate a 15% spare capacity for future expansion.
- C. Submit manufacturer's requirements for testing Device Loop Card circuits and device addresses prior to connecting to control panel. At a minimum the following tests shall be required; device address, the usage (Alarm, Supervisory etc), environmental compensation, temperature ratings for thermal detectors and smoke detector sensitivities. This requirement shall need approval before any wiring is connected to the control panel.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.
 3. Complete drawings covering the following shall be submitted by the contractor for the proposed system:
 - a. Floor plans in a CAD compatible format at a scale of 1/8"=1'-0" showing all equipment and raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
 - b. Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.
 4. Installation drawings shop drawings, and as-built drawings shall be prepared by an individual experienced with the work specified herein.
 5. Incomplete submittals shall be returned without review, unless with prior approval of the Engineer.
- E. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Light fixtures and sensors.
 2. HVAC registers
 3. Fire protection equipment interfaces
 4. Special suppression system interfaces
 5. Audio/Visual devices
- F. Qualification Data: For qualified Installer, Applicator, manufacturer, fabricator, professional engineer, testing agency, and factory-authorized service representative.
- G. Source quality-control reports.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For all fire alarm equipment, to include in operation and maintenance manuals.
- J. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 3. Device address list.
 4. Printout of software application and graphic screens.
- K. Warranty: Sample of special warranty.

1.8 QUALIFICATIONS

A. Supplier Qualifications

1. The manufacturer of the supplied products must utilize multi-channel product distribution on a national basis to be considered for this bid. The manufacturer must have factory branches as well as independent distributors to allow the end user with the ability to utilize factory trained and authorized competitive service providers after system installation and commissioning.
2. 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.
3. 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.
4. The supplies shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
5. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.

B. Installer Qualifications:

1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type and design as specified.
2. The contractor shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.
3. The contractor shall employ on staff a minimum of one NICET level IV 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.

C. Testing Agency Qualifications: Qualified for testing indicated.

D. Source Limitations for fire alarm equipment: Obtain fire alarm equipment from single source.

E. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.
3. Combustion Characteristics: ASTM E 136.

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

G. Preinstallation Conference: Conduct conference at Project site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.
- B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.10 PROJECT CONDITIONS

- A. Installed products or materials shall be free from any damage including, but not limited to, physical insult, dirt and debris, moisture, and mold damage.
- B. Environmental Limitations: Do not deliver or install products or materials until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire alarm equipment that fail(s) in materials or workmanship within specified warranty period.
- B. Warranty Period: 5 years from date of Start-Up and Commissioning.

1.12 EXTRA MATERIALS

- A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:
 - 1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
 - 2. Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.
 - 3. 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.
 - 4. 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.

1.13 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

PART 2 PRODUCTS

2.1 FIRE DETECTION AND ALARM

- A. Manufacturers: Campus Standard – Monaco Enterprises

2.2 MAIN CONTROL PANEL

- A. Existing

2.3 FIRE FIGHTERS' TELEPHONES

- A. N/A

2.4 AUTOCALL SYSTEM INTERFACE

- A. Existing

2.5 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Existing

2.6 DUAL PATH CELLULAR AND IP COMMUNICATOR

- A. Existing

2.7 REMOTE CRTS, PC ANNUNCIATOR, AND PRINTERS

- A. N/A

2.8 SYSTEM PRINTER

- A. N/A

2.9 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 15 minutes.

2.10 ADDRESSABLE MANUAL PULL STATIONS

- A. Description: Addressable single- or double-action type, red Metallic Body, 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.

2.11 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. Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.
 5. Quick Connect Arrangement: Photoelectric sensor and electronics in a single piece construction which shall twist-lock onto a mounting base that attaches to a standard electrical box.
 6. 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.
 7. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.
 8. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
 9. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
 10. Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.
 11. Removal of the sensor head for cleaning shall not require the setting of addresses.
- B. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type. Where acceptable per manufacturer specifications, ionization type sensors may be used.
- C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.

2.12 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 and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
- D. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

2.13 DUCT MOUNTED SMOKE DETECTORS

A. Duct Smoke Detectors – Addressable

1. For duct detector applications, the smoke detector shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.
2. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
3. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.
4. Duct Housing shall provide a relay control trouble indicator Yellow LED.
5. Compact Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
6. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
7. Duct Housing shall provide a magnetic test area and Red sensor status LED.
8. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
9. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.
10. Where indicated provide NEMA 4X weatherproof duct housing enclosure shall provide for the circulation of conditioned air around the internally
11. The duct detector shall be supplied with the appropriate sampling tubes to fit the installation.
12. Where duct detectors are exposed to the weather a weatherproof enclosure shall be available. The duct housing cover shall include a test port for functional testing of the detector without cover removal. The duct housing shall include a cover removal switch capable of indicating cover removal status to the fire alarm control panel.
13. Provide all control wiring, devices, and relays to shutdown the associated mechanical equipment.
14. Provide heated weatherproof enclosure and 120V branch circuit for exterior duct mounted detectors. Extend dedicated 120V circuit from local source.

2.14 ADDRESSABLE INTERFACE DEVICES

- 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 waterflow, 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. There shall be the following types of modules:
 - 1. Type 1: Monitor Circuit Interface Module:
 - a. For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.
 - b. For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.
 - 2. Type 2: Line Powered Monitor Circuit Interface Module
 - a. This type of module is an individually addressable module that has both its power and its communications supplied by the two wire multiplexing signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.
 - b. This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.
 - 3. Type 3: Single Address Multi-Point Interface Modules
 - a. This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
 - b. This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.
 - c. This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

4. Type 4: Line Powered Control Circuit Interface Module
 - a. This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.
 5. Type 5: 4-20 mA Analog Monitor Circuit Interface Module
 - a. This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.
- D. 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.
 - E. Single Device Damper Monitoring and Control: When connected to the FACP, a single switch input shall be able to monitor all 3 states of a damper – open, closed, and in transit. When connected to a FACP, a single relay shall be able to fully control a damper (through the relay connected to the motor control) while also using its switch input for monitoring all 3 states of the damper.
 - F. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dipswitches and rotary switches shall not be acceptable.

2.15 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, 30cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- C. High Intensity Visible/Only: High Intensity Visible/Only: 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 appliance 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 135cd, 177cd and 185cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
- D. 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. A/V appliances shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd, and 110cd. 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.

- E. High Intensity 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. Strobe appliances shall be provided with different minimum flash intensities of 135cd, 177cd and 185cd. 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 appliance shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.
- F. Multi-Tone Audible Only: Multi-tone appliance shall be listed to UL 464. Per appliance tone selection of 520 Hz Horn, Broadband Horn, Bell, Chime, High/Low, Slow Whoop, or Siren shall be selected using an on-board DIP Switch. Output level shall be selectable as high or low. 520 Hz tone shall be compliant with NFPA 72 Low Frequency Signal Requirements for Sleeping Areas. For ease of installation the appliance shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
- G. Multi-Tone 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 and shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135, and 185 candela. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. Multi-tone appliance shall be listed to UL 464. Per appliance tone selection of 520 Hz Horn, Broadband Horn, Bell, Chime, High/Low, Slow Whoop, or Siren shall be selected using an on-board DIP Switch. Output level shall be selectable as high or low. 520 Hz tone shall be compliant with NFPA 72 Low Frequency Signal Requirements for Sleeping Areas. For ease of installation the appliance shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings.
- H. Weatherproof Visible Only: Weatherproof strobe shall be UL 1971 listed for indoor applications with strobe intensity selectable as 15, 60, or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75). The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover, and weatherproof mounting box. The Candela levels shall be selectable by using a hardware selector on the appliance.
- I. Weatherproof Audible/Visible: Weatherproof horn/strobe shall be UL 464 and UL 1971 listed for indoor applications with strobe intensity selectable as 15, 60, or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75). The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The A/V device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover, and weatherproof mounting box. The Candela levels shall be selectable by using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 79 dBA for coded operation at 24 VDC.
- J. 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.
- K. Accessories: The contractor shall furnish the necessary accessories.

- L. Surface mounted devices shall be provided with Manufacturer's custom surface mount back box to blend seamlessly with the device's overall dimensions. Standard sheet metal back boxes shall not be used for surface mounted devices.

2.16 NOTIFICATION APPLIANCE CIRCUIT POWER EXPANSION PANEL

- A. The Power Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be Class A Style Z rated at 2 amps each. Panel shall provide capability to be expanded to 8 notification appliance circuits.
- B. The internal power supply & battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.
- C. The NAC extender panel may be mounted close to the host control panel or can be remotely located.
- D. When connected to a conventional (non-addressable panel) one or two standard notification appliance circuits from the main control panel may be used to activate all the circuits on the NAC power extender panel.
- E. Alarms from the host fire panel shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

2.17 FIRE COMMAND CENTER

- A. N/A

2.18 SURVIVABILITY

- A. The fire alarm system and life safety emergency power systems will be designed and installed for survivability such that attack by fire within an evacuation zone will not impair control and operation of the notification appliances or emergency lighting outside the evacuation zone.
- B. All circuits necessary for the operation of the emergency lighting and fire alarm notification appliances will be protected until they enter the evacuation zone that they serve.
- C. The interconnecting wiring between the Fire Command Center, central control equipment, remote panels, and transponders will be 2-hour fire rated.

2.19 FIRE PUMP

- A. N/A

2.20 DOOR RELEASE

- A. Product Description: Magnetic door holder with integral diodes to reduce buzzing. Provide magnetic door holders as shown on drawings and where required by Authority Having Jurisdiction. Magnetic door holder shall be semi-flush mounted for each door. Coordinate equipment with the door hardware.

2.21 AUDIO SYSTEMS

- A. Provide interface to the audio, sound, and video systems to mute the speakers and disable the electronic acoustic enhancement system.

PART 3 EXECUTION

3.1 PROTECTION

- A. Contractor shall protect all work and material from damage from its work or employees, and shall be liable for all damages thus caused.
- B. Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. Contractor shall protect any material that is not immediately installed. Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.
- C. Project plans and specifications, including the Construction Documents for the new fire pump installation, shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.
- D. Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.
- E. Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate or if any discrepancies occur between the plans and the contractor's work, and the plans and the work of others the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others. Any changes in the work covered by this Specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by and at the expense of this Contractor.
- F. Remove and replace devices and panel components that are wet, moisture damaged, or mold damaged.

3.2 INSTALLATION

- A. Install 14 AWG minimum size conductors for fire alarm detection and signal circuit conductors in conduit.
- B. All wiring associated with the fire alarm system shall be installed in conduit.
- C. Mount end-of-line device in box with last device or separate box adjacent to last device in circuit.
- D. Mount outlet box for electric door holder to withstand 80 pounds pulling force.
- E. Connect conduit and wire to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control panels, duct smoke detectors and all initiating/notification devices.
- F. Automatic Detector Installation: Conform to NFPA 72.

- G. Manufacturer's Field Services: Required.
- H. Demonstration and Training: Furnish 12 hours of instruction each for four persons, with manufacturer's representative.
- I. Perform work in accordance with the requirements of NFPA 70, NFPA 72 and NECA 1-2006, Standard of Good Workmanship in Electrical Contracting.
- J. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.
- K. Wiring Method: Install cables in conduit, unless otherwise noted.
- L. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- M. Provide primary power for each panel from normal/emergency panels. Power shall be 120 VAC service, transformed through a two-winding, isolation type transformer and rectified to low voltage DC for operation of all circuits and devices.
- N. Control panels shall be identified with minimum 1 cm [1/2"] letters on laminated plastic nameplates.
- O. Manufacturers' name plates and UL or CSA labels are to be visible and legible after equipment is installed.
- P. Identifiers shall match record documents.
- Q. Penetration of floor slabs and fire walls/ceilings shall be fire stopped in accordance with all local fire codes.
- R. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- S. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- T. All devices and appliances shall be mounted to or in an approved electrical box.
- U. Any shorts, opens, or grounds found on new or existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.
- V. Contractor shall neatly tie-wrap all field-wiring conductors in the gutter spaces of the control panels and secure the wiring away from all circuit boards and control equipment components. Field-wiring circuits shall be neatly and legibly labeled in the control panel. No wiring except home runs from Life Safety System circuits and system power supply circuits shall be permitted in the control panel enclosures. No wiring splices shall be permitted in any control panel enclosure.
- W. Equipment shall be attached to walls, ceiling and floor assemblies and shall be mounted firmly in place. Detectors shall not be supported solely by suspended ceilings. Fasteners and supports shall be sized to support the required load.

- X. Fire detection and alarm system devices, control panels, and remote annunciators shall be flush-mounted when located in finished areas and may be surface-mounted when located in unfinished areas.

3.3 BOXES, ENCLOSURES, AND WIRING DEVICES

- A. Boxes shall be installed plumb and firmly in position.
- B. Extension rings with blank covers shall be installed on junction boxes where required.
- C. Junction boxes served by concealed conduit shall be flush mounted.
- D. Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.
- E. "Fire alarm system" decal or silk-screened label shall be applied to all junction box covers.
- F. All fire alarm junction box covers shall be painted red.

3.4 CONDUCTORS

- A. Each conductor shall be identified as shown on the drawings at each with wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.
- B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.
- C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits; 18 AWG twisted shielded, speaker circuits; 18 AWG twisted, telephone circuit; 18 AWG twisted shielded.
- D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.
- E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.
- F. The installation contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.
- G. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- H. Product Description: Power limited fire-protective signaling cable, copper conductor, 300 volts insulation rated 105 degrees C.
- I. Fire alarm circuit conductors have insulation color or code as follows:
 - 1. Power Branch Circuit Conductors: Black, red, white.
 - 2. Initiating Device Circuit: Black, red.

3. Detector Power Supply: Violet, brown.
4. Signal Device Circuit: Blue (positive), white (negative).
5. Door Release: Gray, gray.
6. Municipal Trip Circuit: Orange, orange.
7. Municipal Fire Alarm Loop: Black, white.

3.5 DEVICES

- A. Relays and other devices to be mounted in auxiliary panels are to be securely fastened to avoid false indications and failures due to shock or vibration.
- B. Wiring within panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.
- C. All devices and appliances shall be mounted to or in an approved electrical box.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.
- C. A consistent color code for fire alarm system conductors throughout the installation.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Testing General:
 1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
 2. Wiring runs shall be tested for continuity, short circuits and grounds before system is energized. Resistance, current and voltage readings shall be made as work progresses.
 3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the drawings or this specification during testing or inspection by the acceptance inspector shall be corrected.
 4. Test reports shall be delivered to the acceptance inspector as completed.
 5. All test equipment, instruments, tools and labor required to conduct the system tests shall be made available by the installing contractor. The following equipment shall be a minimum for conducting the tests:
 - a. Ladders and scaffolds as required to access all installed equipment.
 - b. Multi-meter for reading voltage, current and resistance.

- c. Two-way radios, and flashlights.
- d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
- e. Decibel meter.
- f. In addition to the testing specified to be performed by the installing contractor, the installation shall be subject to test by the acceptance inspector.

3.8 ACCEPTANCE TESTING

- A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the engineer in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.
- B. A program matrix shall be prepared by the installing contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.
- C. The installing contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.
- D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the owner and test results recorded for use at the final acceptance test.
- E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.
- F. Final Acceptance Test: Notify the owner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until meggar test results, the loop resistance test results, and the submittals required in Part 1 are provided to the owner. Test the system in accordance with the procedures outlined in NFPA 72.
 - 1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
 - 3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
 - 4. Visually inspect all wiring.
 - 5. Verify that all software control and data files have been entered or programmed into the FACP.
 - 6. Verify that Shop Drawings reflecting as-built conditions are accurate.
 - 7. Measure the current in circuits to assure that there is the calculated spare capacity for the circuits.

8. Measure voltage readings for circuits to assure that voltage drop is not excessive.
 9. Measure the voltage drop at the most remote appliance on each notification appliance circuit.
- G. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:
1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:
 - a. Open, shorted and grounded signal line circuits.
 - b. Open, shorted and grounded notification, releasing circuits.
 - c. Primary power or battery disconnected.
 2. System notification appliances shall be demonstrated as follows:
 - a. All alarm notification appliances actuate as programmed
 - b. Audibility and visibility at required levels.
 3. System indications shall be demonstrated as follows:
 - a. Correct message display for each alarm input at the control display.
 - b. Correct annunciator light for each alarm input at each annunciator and graphic display as shown on the drawings.
 - c. Correct history logging for all system activity.
 4. System off-site reporting functions shall be demonstrated as follows:
 - a. Correct zone transmitted for each alarm input
 - b. Trouble signals received for disconnect
 5. Secondary power capabilities shall be demonstrated as follows:
 - a. System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
 - b. System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
 - c. System battery voltages and charging currents shall be checked at the fire alarm control panel.

3.9 CERTIFICATE OF COMPLIANCE

- A. Complete and submit to the Engineer a "Certificate of Compliance" in accordance with NFPA 72, most current edition adopted by the Authority Having Jurisdiction.

3.10 DOCUMENTATION

- A. System documentation shall be furnished to the owner and shall include but not be limited to the following:
 - 1. System record drawings and wiring details including one set of reproducible drawings, and a CD ROM with copies of the record drawings in DXF format for use in a CAD drafting program.
 - 2. System operation, installation and maintenance manuals.
 - 3. System matrix showing interaction of all input signals with output commands.
 - 4. Documentation of system voltage, current and resistance readings taken during the installation, testing and ATP phases of the system installation.
 - 5. System program showing system functions, controls and labeling of equipment and devices.

3.11 DEMONSTRATION

- A. Instructor: Include in the project the services of an instructor, who shall have received specific training from the manufacturer for the training of other persons regarding the inspection, testing and maintenance of the system provided. The instructor shall train the employees designated by the owner, in the care, adjustment, maintenance, and operation of the fire alarm system.
- B. Training sessions shall cover all aspects of system performance, including system architecture, signaling line circuit configurations, sensor and other initiating device types, locations, and addresses, fire alarm control panel function key operation, and other functions as designated by the owner.
- C. Required Instruction Time: Provide 16 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the owner. The instruction may be divided into two or more periods at the discretion of the owner. One training session shall be videotaped by the contractor. Videotapes shall be delivered to the owner.
- D. Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory and trouble. The instructions shall be approved by the owner.
- E. Comprehensive system troubleshooting training shall be provided for a single individual designated by the owner. This session shall be separate and distinct from the above-described sessions.
- F. All training sessions shall be conducted following final system certification and acceptance. Three additional training sessions shall be provided for all security personnel on all shifts six months after final system certification.
- G. All training sessions shall be conducted by an authorized fire alarm system distributor representative, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided.

3.12 SERVICES

- A. The Contractor shall warrant the entire system against mechanical and electrical defects for a period of two (5) years. This period shall begin upon completed certification and test of the system or upon first beneficial use of the system, whichever is earlier.
- B. The Contractor or manufacturer shall offer for the Owner's consideration at the time of bidding a priced inspection, maintenance, testing and repair contract in full compliance with the requirements of NFPA 72. The extended contract for 2 to 5 years and 5 to 10 years shall be individual line items in the bid proposal.
- C. The Owner shall have the option of renewing at the price quoted in the bid proposal for single or multiple years up to five years.
- D. The Contractor performing the contract services shall be qualified and listed to maintain ongoing certification of the completed system to the UL for specific installed system listing.
- E. The Installation Contractor shall furnish training as follows for a minimum of four employees of the system user including fire department personnel:
 - 1. Training in the receipt, handling and acknowledgment of alarms.
 - 2. Training in the system operation including manual control of output functions from the system control panel.
 - 3. Training in the testing of the system including logging of detector sensitivity, field test of devices and response to common troubles.
 - 4. System integration functions and operation.
 - 5. The total training requirement shall be a minimum of 8 hours, but shall be sufficient to cover all items specified and also to ensure seamless integration of fire alarm system to other building systems.

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SECTION 274116.61 - INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Audiovisual Systems for Egner Hall, West Point
 - 1. System for the Glee Club Room
 - 2. System for the Concert Band Room
 - 3. AV racks
 - 4. Control room connection plate
 - 5. Removal and/or protection in place for existing AV patch panels.
 - 6. Relocation of existing patch panels in Glee Club, Concert Band and Control Room.
 - a. Anticipate new wiring for all panels due to change in location requiring longer cables.
- B. Audio Visual System equipment and installation including but not limited to:
 - 1. Loudspeakers, speaker rigging and mounting, custom enclosures, and custom finishes for Acoustic Electro Enhancement System in the Glee Club Room – BASE BID
 - 2. Amplifiers, Microphones, Digital processing for Acoustic Electro Enhancement System in the Glee Club Room - BASE BID
 - 3. For both rooms:
 - a. Digital and Analog tie lines and patch bays – BASE BID
 - b. Projectors and electric screens - ADD ALTERNATE
 - c. Audio Playback system with powered loudspeakers - ADD ALTERNATE
 - d. Lectern unit - ADD ALTERNATE
 - e. Assisted listening system - ADD ALTERNATE
 - 4. Video camera for videoconferencing, Concert Band Room - ADD ALTERNATE
 - 5. All wiring, faceplates, and infrastructure to be installed for the systems noted above as ADD ALTERNATE is in the BASE BID.
- C. Related Sections
 - 1. Electrical
 - a. Audio visual (AV) Contractor and Electrical Contractor shall work in conjunction to ensure proper implementation.
 - b. All sequenced power plates shall be provided by AV Contractor. Electrical Contractor shall be responsible for power termination to plates.
 - c. AV Contractor shall provide all modular vertical power raceways within racks. Electrical Contractor shall provide conduit and power infrastructure into the raceways.
 - d. AV Contractor shall work with Electrical Contractor to ensure proper installation of all conduit, junction boxes, and related cables paths throughout project spaces. Electrical Contractor shall provide all cable paths including junction boxes and back boxes. Electrical Contractor shall provide blank covers for all boxes. AV Contractor shall supply specialty box covers, pass through plates, and connection plates.

1.2 REFERENCES

- A. Contractors shall design, manufacture, test, and install specified systems per manufacturer requirements and in accordance with national codes, state codes, local codes, and the requirements of authorities having jurisdiction.
- B. National Electric Code (NEC)
- C. National Electrical Manufacturer's Association (NEMA)
- D. Underwriters Laboratories (UL)
- E. American National Standards Institute (ANSI)
- F. Electronic Industries Association (EIA)
- G. Telecommunication Industries Association (TIA)
- H. Institute of Electronic and Electrical Engineers (IEEE)
- I. Building Industry Consulting Service International (BICSI)
- J. Audiovisual and Integrated Experience Association (AVIXA)
- K. Donovan, Entertainment Rigging: A Practical Guide
- L. Davis and Patronis, AV Engineering, Third Edition
- M. Ballou, Handbook for Sound Engineers, Fifth Edition

1.3 SYSTEM DESCRIPTION

- A. System Description
 - 1. Glee Club Room
 - a. Complete Acoustic Enhancement System (AES) consisting of distributed loudspeakers, microphones, and digital processing.
 - b. Racks are located on the third floor in the rack room.
 - c. Tie lines for audio, video, and data to the rack room.
 - d. Infrastructure for ceiling mounted projector and portable lectern.
 - 2. Concert Band Room
 - a. Tie lines to the third-floor rack room.
 - b. Infrastructure for ceiling mounted projector and portable lectern.
 - 3. Loudspeaker System
 - a. Performance loudspeaker system shall consist of:
 - 1) Distributed loudspeakers on the walls and ceilings as shown in the drawings.
 - b. System to be fed via independent feeds to each speaker from the DSP system. Feeds to DSP shall be via patch bays and digital sound transport protocol.
 - 4. System Control and Digital Signal Processing for AES system
 - a. System shall consist of Main Core located in amp room rack, sub I/O frames located in amp room.
 - b. System shall control sequenced power system, rack power sequenced modules, amplifiers, and the DSP.
 - c. User interface control shall be via touch panel located in the Glee Club Room
 - d. User Controls to include:
 - 1) System Power ON/OFF
 - 2) Presets for the room

5. Racks and Furniture
 - 1) Provide racks for third floor rack room.
6. System Patching and Connection
 - a. Patching to include Analog audio, digital networked audio, HD-SDI video.
 - b. Analog audio patching to include mic and line plates distributed in the Glee Club, Control Room, and Concert Band Room.
 - c. Digital networked audio patching to be distributed into both spaces as shown in the drawings.
 - 1) All patch points to terminate in patch bays and with a 1GB managed network switch located in the rack.
7. Racks and Furniture
 - a. Provide racks for rack room, control booth, sound porch, stage manager, RF rack, and stage I/O Boxes.
8. System Patching and Connection
 - a. Patching to include Analog Audio, Digital Networked Audio, projection control, HD-SDI video, powered speaker and passive speaker .
 - b. Analog and digital audio and video patching to include mic and line plates distributed throughout.
 - c. All connection plates to terminate at patch bays located in the rack room racks.

1.4 SUBMITTALS

- A. Product Data – Not used
- B. Review (“Shop”) Drawings
 1. Review Drawings, Product Data Sheets and Samples shall be submitted in accordance with Division 1.
 2. All Submittals shall be complete. No partial Submittals shall be allowed without the Consultant’s prior written consent.
 3. Drawings shall show all information necessary to explain fully the design features, appearance, function, fabrication, installation, and use of system components in all phases of operation. These requirements are described in Part 3.
 4. Fabrication, installation, and erection shall not commence until review Drawings have been reviewed by the Consultant and Owner.
 5. Notes or changes to the Review Drawings by the Consultant shall not alter the value of the work where equipment has not been added or deleted or where they are needed to meet the requirements of the Specification.
 6. The AV Contractor shall prepare and deliver two sets of hardcopy manuals, including Record Drawings, as described in Quality Assurance, for review by the Consultant as a portion of Acceptance and Commissioning. After review and revision, deliver four copies to the Consultant, prior to release of holdback. Two (2) copies will then be given to the Owner, one (1) to the Consultant and one (1) to the AV Contractor.
- C. Test Report
 1. Provide this report prior to commissioning by the Consultant.
 2. Failure to provide this report in a timely manner may result in the postponement of commissioning, in the sole discretion of the Consultant.
 3. Provide three (3) copies.

D. Close Out Documents

1. Record Documents shall be submitted in accordance with Division 1: General and Special Conditions.
2. In addition to the requirements referenced above, provide record copy Shop Drawings for archival and reference usage as part of the Operation and Maintenance (O&M) manuals:
 - a. Provide reduced size (11 by 17 inch preferred) hardcopy prints.
 - b. Provide universal electronic format files (PDF file type is preferred) as full-size printable sheets. Submit files on standard PC format CD clearly labeled with project name, project architect, theatre consultant, contractor name, and date of submittal.
3. Include diagrams depicting the system layout and maximum load limitations (drawn not less than 1/4 inch = 1'-0".)
4. Provide three (3) bound copies of the O&M manuals. Manuals shall include:
 - a. Contact information and pertinent manufacturers
 - b. Safety and operational instructions
 - c. Complete parts and subassembly list
 - d. Equipment design parameters such as safe working loads and duty cycles
 - e. Periodic maintenance schedule
 - f. Maintenance procedure for finishes
 - g. Certificates of compliance with applicable codes
 - h. Records of final testing and log
 - i. Spare parts list and source information
 - j. Warranty documentation
 - k. Diagrams depicting the system layout and maximum load limitations, drawn not less than 1/4 inch = 1'-0"
5. Bind all O&M documentation separate from general building sections so they can be turned over to the users after approval.
6. Provide draft copy of completed manuals for review to the Theatre Consultant before the start of commissioning.
7. Provide three (3) hard copies of Shop Drawings, including updates or revisions to the original submission, to accurately reflect the installed system.
8. Provide complete copies of the following electronic files:
 - a. Final Shop Drawings in their native electronic files (AutoCAD or similar) including all relevant x-refs bound into backgrounds as required.
 - b. Submittal files, including Shop Drawings, in a PDF format.
9. Submit files on standard pc format CD clearly labeled with project name, project architect, theatre consultant, contractor name, and date of submittal.

1.5 QUALITY ASSURANCE

- A. AV Contractor shall meet the following requirements and provide the following documentation in bid package:
1. Be a firm with at least ten (10) years experience in which the primary scope of work is in the fabrication, assembly, and installation of audiovisual systems of similar magnitude and quality of the system specified herein.
 2. Specify no less than three (3) projects of same or greater magnitude as system specified herein in which the AV Contractor was prime contractor. AV Contractor shall provide a summary of scope

- in each of the specified projects. AV Contractor shall provide current contacts as references on each of the three specified projects.
3. Identified site supervisor shall have no less than five (5) years direct professional experience with equipment and system installation of system specified herein. Supervisor shall have CTS-I and OSHA 80hr certifications.
 4. Identified project engineer shall have no less than five years direct professional experience with equipment and system installation of system specified herein. Engineer shall have CTS-D certification.
 5. All personnel engaged in the installation of the system specified shall have at least three (3) years direct experience with equipment and system installations of same or greater magnitude.
 6. AV Contractor must make known to Owner, Construction Manager, and Consultant the intent to use subcontractors at the time of bidding. All subcontractors shall comply with same quality assurance requirements as AV Contractor.
- B. All work shall be in compliance with governing codes and regulations of the authorities having jurisdiction.
1. Drawings and specification requirements shall govern where they exceed Code and Regulation Requirements.
 2. Where requirements between governing codes and regulations vary, the more restrictive provision shall apply.
 3. Nothing in the Contract Documents shall be construed as authority or permission to disregard or violate legal requirements.
- C. Quality of Materials and Equipment
1. All materials and equipment supplied by the AV Contractor shall be new and shall meet or exceed latest published specification or the manufacturer in all respects.
 2. The AV Contractor shall supply the latest model, available at the time of bidding, of each piece of equipment.
 3. The materials and completed work in this section shall conform to the applicable requirements of all current local and state codes.
- D. AV Contractor shall provide mockup of intended touch screen control pages to Consultant prior to field installation.
- E. AV Contractor may be required to provide color coordinated examples or wall plates, speakers, and other devices that require color coordination with finished surfaces as directed by architect.
- 1.6 Delivery, Storage, and Handling
- A. The AV Contractor shall provide his or her own secured job box(es) for all parts and tools.
 - B. The AV Contractor is responsible for loss of any and all system equipment until it is permanently fastened to the building or signed over to the Owner and in the Owner's secure storage area.
 - C. The AV Contractor shall maintain an orderly work area and ensure conditions meet industry standards and statutes for safety and work procedures.
 - D. The AV Contractor shall maintain an orderly work area and ensure conditions meet industry standards and statutes for safety and work procedures.

- E. Except as noted, the AV Contractor shall be responsible for all cutting and patching related to the specified work and shall make good all damages to the site that result from the AV Contractor's activities.
- F. The AV Contractor shall ensure replacement and or restoration to original condition any damage or alteration to floors, ceiling, walls, furniture, etc. caused by the installation process.
- G. The AV Contractor is responsible for removal from the site of all garbage resulting from his or her installation, at no additional cost to the client.
- H. Access to the site will be granted only at the discretion of the Owner. The AV Contractor's site supervisor shall coordinate closely with the Owner's security service to ensure unobstructed access to the site.

1.7 PROJECT CONDITIONS

- A. The AV Contractor shall confirm that all dimensions, distances and site conditions are suitable prior to the installation of equipment. Report any discrepancies to the Consultant prior to installation.
- B. The work shall be deemed substantially complete when it is fully functional, ready for operation by the Owner and has been tested and commissioned. The work shall be deemed 100 percent complete when all deficiencies are rectified, the system manuals have passed review by the Consultant and all contractual requirements are satisfied.
- C. Acceptance of systems design and performance shall be at the sole discretion of the Consultant.
- D. The AV Contractor shall closely coordinate with the Consultant regarding any element of the AVs that may have visual impact in the public or performance spaces.
- E. The standards for quality of supply and installation shall be as stated herein and consistent with current trade practices, to the satisfaction of the Consultant.
- F. Unless otherwise noted herein, all equipment supplied under this specification shall be new stock.
- G. During the review drawing process, the AV Contractor shall propose modifications to the cable specification types and quantities, as necessary to meet the requirements of the installed equipment, to the satisfaction of the Consultant.
- H. The AV Contractor shall coordinate with the Electrical Contractor regarding the installation of the conduit, raceway, and back boxes to ensure it meets the needs of the systems specified herein.
- I. Upon award of contract the AV Contractor shall review all reference drawings and site conditions and report any discrepancies, including conduit routing and sizing, to the Consultant. Measures to circumvent such discrepancies shall be incorporated in the review drawings.

1.8 SEQUENCING – NOT USED

1.9 SCHEDULING

- A. The AV Contractor is responsible to complete his/her activities according to the identified schedule milestones.
- B. The AV Contractor is to provide the necessary number of qualified personnel at such times as meet the above requirement.
- C. After the scheduled finish of the Work, access to the site will be at the discretion of the Owner.

- D. All Submittals shall be made in a timely manner, allowing two (2) weeks for review and two (2) weeks for possible resubmission, so as not to jeopardize the project schedule.

1.10 WARRANTY

- A. The warranty period is one (1) year from final acceptance.
- B. Warrant installation, systems, and equipment to be free of defective components, faulty workmanship or improper adjustment. Replace items showing evidence of defective design, materials, or workmanship (including installation workmanship). Make replacements without cost to the Owner.
- C. Provide warranty service on site during the warranty period. Response time by phone will be within two (2) hours, 7 AM to 11 PM. Response time for on-site service will be provided within forty-eight (48) hours. Notwithstanding the foregoing, rectify conditions that might present a hazard to human life, well-being and or property within twenty-four (24) hours.
- D. All equipment supplied under this contract shall be obtained through the distribution channels authorized by the equipment manufacturers. In this way, the equipment will be guaranteed by a distributor or representative and can readily be serviced.
- E. Designate warranties on manufactured equipment to the Owner.
- F. Some manufacturers of equipment supplied under this contract may offer warranties which exceed one (1) year in duration. The AV Contractor shall inform the Owner of such warranties, via a letter to be included in the manual, and shall manage the servicing of the warranties at no charge to the Owner. However, the Owner will be responsible for transporting failed equipment to the premises of the AV Contractor for warranty service after the one-year warranty under this contract has expired.
- G. All software shall have a Guarantee/Warranty. Any faults, inadequacies or deficiencies found during the first year of service (start date being at 100 percent completion award) shall be corrected at no cost to the Owner. The AV Contractor shall provide all necessary site labour to reinstall and fully test the revised software. All changes shall be reported to the Consultant.
- H. Any and all software updates shall be provided free of charge during the Guarantee/Warranty period.
- I. Provide maintenance service for a period of one (1) year after final acceptance of the installation. This service consists of two (2) visits to the site for checking and adjusting of equipment. Perform the first visit six (6) months after the system has been accepted. Arrange visit to be at a time mutually agreeable to the Owner.
- J. The AVs Contractor shall notify the Owner in writing of the warranty period expiration date sixty (60) days prior to end date. Prior to warranty expiration the Contractor shall arrange a visit time mutually agreeable to the Owner and ensure all software or firmware installed on all AVs is current with manufacturer's releases.
- K. Provide a 1-year service and maintenance agreement for the AES system. Provide unit price in schedule of values.

1.11 ACCEPTANCE AND COMMISSIONING

- A. After the Consultant has received and inspected the AV Contractor's test report, the AV Contractor shall, on or after the scheduled delivery date, at a time acceptable to the Consultant and other representatives of the Owner, provide at the AV Contractor's expense all the test equipment and technician assistance required to demonstrate all the tests described herein. During the same acceptance session, the AV Contractor may also be required to repeat any portion or portions of the testing. Acceptance by the Consultant, in writing, shall constitute substantial completion.

- B. Should the Work not be substantially complete at the scheduled time of inspection, the AV Contractor may be held responsible for any consulting and transportation costs incurred during subsequent inspection or inspections.
- C. If the system does not fulfill all aspects of this Specification, the AV Contractor must make any adjustments, or any other changes required, to bring the installation into conformance with the specification.
- D. Allow minimum four days on site, with two technicians with test equipment to demonstrate and adjust systems at the direction of the Consultant.
- E. Prior to final acceptance, after notifying the AV Contractor, the Owner may require use of the system for testing or other purposes. The AV Contractor shall not waive any responsibility because of this temporary use of the system, and it shall not be construed as evidence of acceptance.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Equipment Substitutions
 - 1. Refer to General Conditions for equipment substitution procedures.
 - 2. Electronic Acoustic Enhancement System is to be provided as a complete manufacturer solution from a single supplier. The supplier of the system may use components from multiple manufacturers. Any substitutions of these components must be approved by the system supplier and shall be of equal or better performance than as designed.
 - 3. All intended substitutions must be outlined in bid documents per General Conditions.
 - 4. If listed equipment model is no longer available, a model of equal quality and feature set can be specified.
 - 5. AV Contractor shall work with Consultant in all instances of substitution to insure substitutions will maintain the intended quality and functionality of design.
- B. Equipment listed below shall not be considered a complete listing of products and materials required to complete scope of work.
 - 1. Equipment listed below is intended to identify major components included in scope work.
 - 2. Items such as rack hardware, shelves, screws, rigging hardware, power supplies, and adapters may not be listed.
- C. This specification section describes the AVs required.
- D. All equipment will be installed within the boundaries of the building construction as shown on the drawings. All equipment installed to be of new stock.
- E. See drawings for specific and/or typical details of equipment arrangements and connections.
- F. Acoustic Enhancement Systems
 - 1. The acoustic enhancement system shall consist of system components assembled by the supplier/manufacturer of the system.
 - 2. The installer shall not substitute products or attempt to assemble a system on their own.
 - 3. The system shall be server based, housed in racks located in the AV rack room.
 - 4. The system shall include an intuitive stand-alone control system with interface for the end user.
 - 5. System shall employ high quality microphones and loudspeakers.

6. The system shall be from one of the following manufacturers, there are no approved equals:
 - a. E-coustic Systems, Belmont MA, 617-484-9266
 - b. Acoustic Control Systems, Windermere, FL 407-876-7080

PART 3 - EXECUTION

3.1 INSTALLERS

- A. In the provision of the work specified herein, a supervisor shall be onsite for all workdays to execute, coordinate, and participate in the work by qualified installers.

3.2 TECHNICAL STANDARDS

A. General

1. All equipment shall be installed so as to present no safety hazards to the public, to operating personnel, to equipment or to other trades.
2. All equipment must be adequately ventilated when operating under worst-case power dissipation.
3. Materials and equipment required for a complete system but not specified herein as to manufacturer or quality shall be of high commercial standard and quality.
4. The AV Contractor shall confirm all dimensions distances and placement prior to the installation of equipment. Report any discrepancies to the Consultant.
5. All UPS and surge suppression equipment to provide sinusoidal output and must not bleed harmonics to ground.
6. The AV Contractor is responsible for removal of all garbage resulting from his installation, from the site at no additional cost to the client.

B. Review Drawings

1. Notes or changes to the Review Drawings by the Systems Engineer shall not alter the value of the work where equipment has not been added or deleted or where they are needed to meet the requirements of the specification.
2. Review drawings are defined as those drawings necessary to build the job to the standards and detail as outlined in this specification and shall include:
 - a. Block diagrams showing the interconnection of all equipment. These drawings shall detail a shield ground scheme. For each wire or wire group, show wire numbers and wire type. Identify device connection at each termination. For each device or device group, identify type, model, and location. For each multi-pin connection, provide pin/conductor/function schedule.
 - b. Conduit/cable diagram(s) showing all system conduit, cable, and cable numbering.
 - c. Schematic diagrams showing detailed wiring interconnections of all custom assemblies, terminal strips, terminal blocks, multi-pin connectors.
 - d. A master functional schematic drawing that demonstrates the functionality and signal flow of the system. This drawing is for use by operators for reference. This drawing shall be sized so that all wording is legible. The drawing shall be laminated and a copy mounted in the rack room.
 - e. Include all panel layouts and specifications.
 - f. All metal work assemblies where custom made by AV Contractor.
 - g. Equipment rack layouts and specifications including AC power distribution.
 - h. Portable rack layout and details where custom and made by AV Contractor.

- i. Furniture layout and details where custom and made by AV Contractor.
 - j. For every loudspeaker type, provide an assembly drawing which shall describe or include at least the following: complete bill of materials with load ratings; dimensioning; relationship to architectural surrounding; all hardware; all frame and structural elements; rigging apparatus for suspending, aiming, and adjusting the loudspeakers; finish and color schedule.
 - k. Other drawings noted in the specification.
 - l. Complete testing checklists and documentation, ready for use in the field.
 - m. Any other diagram or information required for a complete description of the system(s).
3. Format and details of review drawings must meet the standards exemplified by the tender drawings. The tender drawings are available in electronic form upon request.

C. Record Drawings

- 1. Record drawings shall include:
 - a. Review drawings, revised to reflect as-built changes
 - b. Other drawings noted in the Specification
 - c. Any other diagram or information required for a complete description of the system(s)
- 2. Designations and settings of all signal processing equipment (analogue and DSP based) and other controls.
- 3. Equipment manufacturers' operating instructions and maintenance manuals
- 4. Performance data on the completed system as specified under performance testing (Part 3.2); (one manual only) For any computer or microprocessor-based control or signal-processing systems for which custom programming is required: complete licensed development environment, compiler software and manuals and project-specific source code, custom or specially licensed executables and libraries; configuration, design or script files in uncompiled form, and set-up files on CD-ROM for modification and maintenance of this installation only, by the Owner.
- 5. On the cover page of the manual detail the names, addresses, phone numbers and contact names of all contracting, consulting and management firms involved in any aspect of the AV implementation.
- 6. The following is to be included in the system manual, on a separate page, immediately after the table of contents: "Hearing Damage Advisory – Various audio systems in this installation are capable of damaging the hearing of patrons, talent and staff if operated incorrectly and/or contrary to standards, such as OSHA, established and maintained for the protection of hearing. In particular, be advised that headphones and sound reinforcement loudspeaker systems can cause rapid and permanent hearing damage if operated unsafely. All of the AVs are to be operated and maintained only by qualified and authorized personnel."

D. System Manual

- 1. The System manual shall contain at least the following:
 - a. Detailed Table of Contents
 - b. Contacts and credit page
 - c. User operating instructions, which detail operation of the various systems for the day-to-day user (includes all control panel layouts, screen dumps etc.)
 - d. Include Technical manual(s), which detail service procedures for all systems:
 - 1) Audio, Video
 - 2) Amplifier control system
 - 3) Digital systems

- 4) Software technical detail that covers all aspects of the GUI's, presets, modes of operation, and programming so that service personnel can fully understand and trouble shoot the system.
 - e. Include manufacturers' product manuals and product literature for all components.
 - f. Include clean copies of all shop and as built drawings as specified elsewhere.
 - g. Miscellaneous equipment drawings, custom fabrication drawings
 - h. Miscellaneous equipment manuals
 - i. Include a section with copies of all approvals, Engineer's stamps, etc.
- E. Software Standards – Writing and Documentation
1. All software programs and their associated hardware components must be fully installed, programmed, and configured. Where a network system is used all connections to the hardware and software must be tested and fully operational.
 2. Before the system is deemed complete and ready for final acceptance all software and hardware issues must be rectified.
 3. All software programming must be performed by manufacturer trained and authorized personnel.
 4. Where security features with passwords are employed the AV Contractor shall ensure that each level is properly assigned and that all the users have access as directed by the Systems Engineer. The AV Contractor must submit to the Systems Engineer for review all security features prior to commissioning. Unless otherwise noted the AV Contractor shall keep a set of passwords that permit full access to the system for future technical support to the client.
 5. Where DSP systems replace any analogue equal loudspeaker-processing devices the AV Contractor shall consult the original manufacturer of the loudspeaker system to obtain the recommended factory settings for that loudspeaker system. The settings shall be implemented as algorithm 'Blocks' in the DSP. These settings shall be printed in a tabular format and included in the system manuals.
 6. All software programming shall meet manufacturer's recommendations and best industry practices. The AV Contractor can expect that the manufacturer may be requested to review their programming. At the discretion of the Systems Engineer, the AV Contractor may be directed to modify their program to the manufacturer's directions.
 7. Two complete copies of the software and programming shall be delivered to the Client and the Systems Engineer with the system manuals. The storage medium shall be CD-ROM.
 8. All software and programming shall be warranted for a minimum period of one (1) year from date of acceptance.
- F. Software Standards – Approval and Testing
1. The AV Contractor shall submit proposed block diagrams that indicate functionality, logic flow and network connections. In the case of DSP systems these block diagrams shall also indicate signal flow.
 2. All software shall be fully tested on the AV Contractor's premises prior to testing on-site. A report shall be submitted regarding this shop testing. The Systems Engineer may choose to witness the testing or have the shop testing repeated, at his/her discretion.
 3. All software programs must be fully functional and tested for interoperability and compatibility, which includes stand alone PCs and or those operating across a network.
 4. Where a system includes operational screens, include diagrams or screen dumps that demonstrate all the Graphical User Interface (GUI's) screens.

5. Prior to commissioning, the AV Contractor shall submit all software programming files to the Systems Consultant for review. The number of submissions required shall be at the discretion of the Systems Consultant.
 6. The AV Contractor can expect several iterations of the review process before the Systems Engineer agrees to final configurations.
 7. During software development all software submissions shall be accompanied by documentation describing the following:
 - a. The intent of the program
 - b. Table of presets
 - c. Logic function table
 - d. Any problems related to the software and proposed solutions.
 8. All software storage medium and storage containers shall be clearly labelled with the following:
 - a. Project
 - b. Date
 - c. Program
 - d. Contents and revision date
 - e. Computer System Hardware
 9. The computer system must not be installed on site during construction where there is dust and debris.
 10. All computer system components shall be of premium quality and sourced from an established vendor.
 11. The AV Contractor shall fully test the computer systems and software systems off site and a report submitted to the Systems Engineer. The Systems Engineer may choose to witness the testing or have the shop testing repeated, at his/her discretion.
 12. All network cabling, connectors and components shall be tested for full bandwidth and proper functionality.
- G. Control and Interface Hardware
1. Various systems and components may be controlled directly from a custom switch panel or via a dedicated control system. These devices are key components in delivering a usable system. Therefore, their successful implementation is of great importance.
 2. All software standards and the review process as described previously shall apply to these systems.
 3. All hardware components used to control and interface with the computer system or other hardware components shall be tested and fully functional prior to installation on site.
 4. Unless otherwise noted, software programs that control operable machinery must require tally from the mechanism being controlled. The software program shall report the status of the mechanism to the user via a graphic display. Where injury or damage to equipment may occur the control program must include safety features that reverse motion or stop movement until the problem is rectified.
- H. Spares and Miscellaneous
1. As part of this specification the AV Contractor shall provide the following:
 - a. Where applicable provide cleaning kit(s) for all recording and playback devices.
 - b. Provide spare set of bulbs for each lamp described or inferred in the specification.
 - c. Extender cables for the console rails to permit servicing.
 - d. Three sets of batteries as required by each battery powered device.

I. Definitions of Technical Performance Criteria

1. Technical Performance Criteria for loudspeakers as quantified in this specification are defined here:

Performance Criterion	Values	Definition
Maximum Sound Pressure Level (SPL)	See spec.	This is the maximum long-term SPL capability as measured with a Sound Level Meter, A weighted, slow response (average) Measured on axis of loudspeaker Measured at ear height at intended listening position. Measured in free field (direct plus reverberant) with Omni microphone Measured after system is equalized to installed frequency response
Direct Sound Pressure Level (SPL)	See spec.	This is the maximum long-term SPL capability as calculated from manufacturer's data and location design data using inverse square law or approved computer design package, A weighted, slow response (average) Measured on axis of loudspeaker Measured at ear height at intended listening position. Measured after system is "equalized" to flat frequency response
Coverage Area	See spec.	The area within which the off-axis attenuation of the direct sound of the loudspeaker is less than 6dB at 2kHz. Coverage of surfaces outside the stated listening area shall be strictly minimized.
Coverage Variation	See spec.	This is the variation in A-weighted SPL due to listener location within the coverage area of the loudspeakers As measured in the room free field Measured at ear height at intended listening position
Passband (Bandwidth)	See spec.	Nominal operating range of unequalized loudspeakers Determined by 3 dB down points of raw frequency response
Raw Frequency Response	See spec.	Anechoic response as published by manufacturer
Installed Frequency Response	See spec.	Measured on-site after optimization of aiming and equalization Unless stated otherwise, this shall be flat (maximum +1/-3dB on 1/3 octave intervals) within pass band at max. SPL
Loudspeaker Headroom	See spec.	Nominal long-term power handling capability above that needed to achieve max desired SPL, expressed in dB
Amplifier Headroom	See spec.	The difference between the EIA power rating of power amplifier and the power required to achieve maximum SPL, expressed in dB

J. Wiring and Cable Termination

1. The AV Contractor shall take all necessary precautions to prevent electromagnetic and electrostatic interference. Care should be taken during wiring and installation to prevent damage to wire or equipment. It is expected that the AV Contractor will use best industry practices to ensure long-term reliability.
2. All terminations of shielded twisted pair cables, regardless of location, shall consist of a Teflon, PVC or neoprene sleeve covering the shield drain wire and an overall heat shrink or elastic

neoprene sleeve covering the point at which the cable jacket and shield end. (This makes it very difficult to inadvertently ground a shield and is an important aspect of audio system wiring.) At the termination the unshielded leads shall be less than 50 mm in length but not so short as to present undue stress of the soldered joint.

3. All wiring entering the racks shall have a 2 m service loop (slack) folded after the cable has been terminated, allowing future rewiring. This slack wire shall be neatly harnessed into place.
4. All cable and cable bundles shall be neatly and logically routed and organized. Bundles of varying signal level shall be spaced at least 10 cm apart and secured to dedicated tie bars. Wiring in racks shall not be left unsupported.
5. The AV Contractor shall not attach cables to the fire-sprinkler system, electrical distribution of any system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that operation of any valves, fire panels, access doors, or control devices are not impeded.
6. Install all cables in continuous lengths from origin to destination. Splices are unacceptable.
7. Audio and control terminations shall be made with rosin-core solder or an approved mechanical connector. Temperature controlled soldering stations are recommended. Crimp only with manufacturer's recommended crimping tool having a controlled crimp cycle.
8. Mechanically connected XLR and phone plugs will not be allowed.
9. RF terminations shall be made with screw-on BNC connectors on cables and isolated thru-panel BNC-BNC connectors on panels.
10. As some audio signal cables may share a conduit with control cables (e.g., paging mics), take appropriate precautions to prevent pops and clicks in the system. Control circuits that require a reference shall not share audio shields as their reference.

K. Audio Interconnection

1. All microphone and line level wiring outside of racks shall be balanced and floating, unless otherwise indicated.
2. All microphone and line level wiring to be balanced, except where specified equipment has unbalanced terminations.
3. Unless otherwise noted, all microphone and line level connections to be via XLR connectors, except console inserts.

L. Cable and Connectors

1. Terminate and connect wiring harnesses, as described under Equipment, to implement connection schemes as described in *Audio Systems Design and Installation*, P. Giddings (Focal Press) p. 236. Unless otherwise noted, all balanced audio wire to terminate to XLR3 or 3-pin Phoenix type connectors. If equipment is not fitted with XLR or Phoenix connectors, or if direct XLR connection contributes to a noise problem, AV Contractor to provide XLR adapter to match. Wiring modifications are made in this adapter only and shall be appropriately identified.
2. Unless otherwise specified herein, as indicated by an equipment model number, all audio line output impedances shall be less than or equal to 200 ohms and shall be capable of driving loads of 600 ohms. All audio line input impedances shall be greater than or equal to 600 ohms, and preferably ten times greater than the source impedance. Similarly, all microphone output impedances shall be less than or equal to 200 ohms and capable of driving loads of 1000 ohms or greater. All microphone input impedances shall be greater than or equal to 1000 ohms. The values specified here are measured rather than "nominal" values. The Systems Engineer must review exceptions to the above.

3. The polarity convention for connectors in balanced circuits shall be defined as follows. This polarity convention shall be clearly noted on each wiring diagram and in the manuals. The polarity and/or pin assignment schemes of all other connectors shall be detailed in the review drawings.

Connector Type	Shield	Hot (+)	Return (-)
XLR type connectors	Pin 1	Pin 2	Pin 3
One-quarter inch phone plugs and jacks	Sleeve	Tip	Ring

M. Video Interconnection

1. All BNC type video connectors shall be of high quality with a crimp style strain relief.
2. All other "line level" type video connectors shall be of high quality with the opposing mating surfaces composed of similar metal types.
3. Ensure that all Video transmission paths are properly terminated with the appropriate device.

N. Control and Data Interconnection

1. All data and control connectors shall be of high performance and quality.
2. All opposing mating surfaces shall be of similar metals.
3. All connections shall maintain telecommunication industry defined impedances for that particular circuit type and connection.
4. Ensure that all Data and Digital transmission paths are properly terminated with the appropriate device.

O. Fibre Optic Connections (Where specified)

1. All connectors shall be of premium quality and performance.
2. All terminations shall be made by field experienced personnel.
3. Only industry standard connection methods shall be permitted.

P. Cable Types:

Q. Unless otherwise called for in these specifications and drawings, use the following cables, or their approved equals, in these systems:

1. Multi-mic Cable for stage Multi-Mic panels and stage snake boxes: Canare Star-Quad
2. Multi-Channel cable for portable console/rack systems: Canare MR202-32AT
3. Video cable for runs not exceeding 200 feet between active devices: Belden 8279
4. Video cable for runs exceeding 200 feet between active devices: Belden 8281
5. Plenum-rated video cable: Belden 88281
6. Microphone and line-level audio cable in conduit: Belden 1800B
7. Microphone and line-level audio cable for rack wiring: Belden 8761
8. Low-impedance speaker cable: Belden 8473
9. 70-volt speaker cable: Belden 8461
10. Plenum-rated 70-volt speaker cable: Belden 89740
11. RF cable for major vertical trunk runs: Jerrold CAC-6
12. RF cable for horizontal runs and outlet connections: Jerrold CAC-11

13. RF cable for head-end rack connections: CommScope F59-HEC
 14. Camera cable: Belden 9232
 15. Control cable: Belden 9740, 9156, 8690, 9157, 9159, 8691, 9161
 16. Plenum-rated control cable: Belden 89740, 82489
 17. Multi-Mode Fiber Optic Cable: CommScope LazrSPEED 150 Type 5M or equal
 18. CAT-5/6 Cable Extron XTP DTP 24 or equal (shielded)
- R. Receptacle Plate Connectors:
1. Unless otherwise detailed herein, use the following types of panel receptacles on connection boxes, panels, plates, and wireways:
 2. Audio (microphone): XLR (female) type, without locking tab, such as Switchcraft E3DSCB (No latch)
 3. Audio input/output (line-level): 1/4 inch diameter tip/ring/sleeve type. Insulate from panel.
 4. Audio (loudspeaker level): Neutrik Speak-on type. Insulate from panel.
 5. Intercom: XLR-3 (male) type.
 6. Video: BNC type. Insulate from panel.
 7. RF: F type. Insulate from panel.
 8. Fiber Optic: Neutrik Opticon
 9. Camera: Digital CAT 6 with balun as indicated in the drawing.
 10. Wired Remote Control (multiplex signal): XLR-6 (female) type.
 11. R232-DB-9 connector Belden 9534
 12. Wired Remote Control (relay contacts): Neutrik Neutricon

3.3 MARKING

- A. Equipment
1. Label all equipment as per drawings, so that every patch point can be immediately associated with a specific piece of equipment. That is to say the connector shall be identified with the device it is normally connected to.
 2. All operating controls, switches, jacks, plugs shall be permanently marked in a clear logical manner utilizing engraved or screened letters, Brother P-Touch strips, or lamacoid label strips. Dymo or similar label strips or hand printed labels are not acceptable.
- B. Wall Panels
1. Each wall panel including microphone, line, loudspeaker, video, intercom, and control panel outlets shall be engraved and filled or silk screened to indicate the physical location of the outlet, its designation and the circuit numbers it terminates. Font shall be Bold Helvetica, 1/4 inch for panel location and designation and 3/16 inch for circuit numbers.
 2. Alternatively, laser engraving and or die cut overlays may be used. The style or "look" must be uniform throughout the entire facility and must be submitted to the Systems Engineer for approval prior to manufacturing.

C. Jack Fields and Rack Mounted Panels

1. Jack fields shall be labelled using CAD-generated label strips. The labels shall indicate the name and function or circuit number of each circuit. Font shall be Bold Helvetica, sized 1/8 inch or as space permits. Submit scheme to Systems Engineer for approval prior to manufacturing.
2. Patch field panels shall have a label strip as shown in the drawings, with a transparent retaining cover.

D. Wire

1. Without exception, all audio, video, data, and control system cables to be individually, uniquely, logically, and permanently marked by the AV Contractor. All wires shall be marked as documented on cable risers and system drawings. All spare wires shall be marked "spare" at both ends and numbered consecutively. A "spare schedule" shall be provided on the risers indicating spare wire numbers, locations, and types. Wires shall be marked with slip-on or other permanent type sleeves. Cloth or vinyl tape type markers are not adequate and should be replaced by a more permanent type such as Brady DATAB labels. All wiring shall be properly identified in junction boxes and at terminal blocks and wherever accessible.

3.4 EQUIPMENT PACKAGING

A. General

1. Unless otherwise noted, all equipment shall be securely mounted and fastened into racks using either the original manufacturer's rack mounting kits or custom fitted mounting kits. Unless otherwise noted, it shall be unacceptable to put equipment loosely on shelves or stacked on top of other rack-mounted equipment.

B. Panels

1. Blank and vent panels, shall be of consistent color and finish. Panels of four (4) or less Rack units high shall be used to enclose all remaining rack openings after equipment is installed. All panels shall have a black baked enamel or equal finish.
2. Provide perforated metal vent panels as required to implement rack ventilation scheme when convection cooling is required. If equipment is forced air-cooled blank panels between equipment shall be solid.

C. Portable Systems Racks (where specified)

1. Provide cabinets constructed of 14-ply birch plywood, surface finish suitable for staining. Stain black and finish with satin polyurethane.
2. Cabinets shall not be more than 21-1/2" wide and 24 inches deep unless specified otherwise. Heights are as shown in the drawings. The top and bottom planes of the cabinet shall incorporate a recess on the rear edge to permit passage of cables while the cabinet is located against a surface to the rear.
3. Cabinets are to be fitted with convection-cooling vents; "PENN Manufacturing"-style spring-loaded self-retracting oversized handles; combination rack rails (punched to accommodate Hammond 10/32 clip nuts), front and back, as shown in the drawings, black enamel finish, drilled. External metallic fittings are not to be continuous (in contact) with rack rails or equipment. External metallic fittings are to be finished in black enamel.
4. Cabinets taller than 21 inches are to be fitted with four (4) high-quality, non-marring locking casters, 4 inches wheel diameter.

5. Cabinet finishes are to be of a common uniform stain, color to be "charcoal", with an overall dent and scratch resistant satin polyurethane finish. Provide color samples to the Architect for approval.
 6. Provide an Approval drawing of this equipment for review prior to construction.
- D. XLR and Multiconnector Panels (where specified)
1. Supply and install multichannel connector panels, as shown in the drawings. Provide balanced lines inside rack extending each channel to rack devices or patch bays. Except where lines are connected to patch bays, all cables to terminate to XLR of gender appropriate to direction of signal flow, including spares. Cut cable to harnessed length plus 24 inches.
 2. Panels to be 19 inches by 2RU in height, of #16 C.R.S. folded back 1/2 inch top and bottom, with black enamel finish, having twenty-four (24) XLRs rear-mounted in two rows of twelve (12) male and twelve (12) female respectively. Terminate the connectors to the multichannel connectors as shown in the drawings.
 3. All panels regardless of type to have a self-contained integrated "tie-bar" to support cables at the rear of the panel.
 4. All jack panel designations shall be silk-screened or include a label strip above each row.
- E. Installed (Fixed) Racks (where specified)
1. Where freestanding racks are required, provide modular steel equipment racks complete with pairs of formed dress panels, removable sides and a bottom dress skirt as required for a completed professional look and finish. Top panel shall be either solid or vented depending on equipment cooling requirements. Perforated rear doors with flush key locks are required.
 2. Where wall mounted racks are required, provide swing-out steel racks with locking front doors and louvered sides. Front door may be perforated depending on equipment cooling requirements.
 3. Racks to have chip-resistant satin enamel finish, color black.
 4. Each rack to have a permanent work light with switch mounted at rear top of rack to assist in service.
 5. Each rack to have adjustable front and rear mounted rails tapped with #10-32 mounting holes.
 6. Racks shall be fitted with isolated ground power distribution bars and ground busses (where isolated ground technical power is provided) as shown in the drawings Provide a standard 15A/120VAC duplex courtesy outlet at the front base of the rack uniquely identified as an isolated ground outlet.
 7. Provide blank and or perforated metal vent panels, (dependent on cooling requirements) and install a one rack unit panel above and below each power amplifier if convection cooled. Provide blank and or perforated metal vent panels in all unused rack spaces at front of rack. Provide fine perforated metal security panels to cover all equipment with front mounted controls to prevent tampering with the final settings by inexperienced users.
- F. Multichannel Cables (where specified)
1. All multichannel cables for audio, video and RF shall incorporate an individual jacket with shield for each circuit and an overall flexible outer jacket.
 2. Where cables enter racks, secure the cable with Kellems-type strain relief grip mounted in a 16 C.R.S. panel, top and bottom folded back 1/2", finished in black enamel consistent with other panels in the system.
 3. Provide an approval drawing of this equipment for approval prior to construction.

- G. Line Level Patch bays (where specified)
1. As shown in the drawings and as required in this specification, supply and install TRS-type jack fields with hinged faces. Terminate the patch points to the multichannel connectors as shown in the drawings. Make normal connections between patch points as shown in the drawings and as directed by the Systems Engineer.
 2. Cables shall be dress to the hinge area to allow smooth operation of the hinged face. Provide an approval drawing showing the cable harness scheme for approval prior to construction.
 3. All jack panels shall be fitted with fully labelled designation strips contained in aluminum retaining channels permanently affixed above each row, except where designation strip impedes operation of the jack.
 4. Provide "mults" and spares on jack field.
 5. Supply TRS and or XLR patch cords 2 feet and 3 feet long or as required.
- H. Power Amplifiers
1. Install power amplifiers in the appropriate equipment racks. Support the weight of the amplifier with angle brackets attached to the side rails of the equipment rack or with the rear support flanges provided with some amplifiers so that the front panel of the amplifier is not subjected to torsion. Attach a label, as specified elsewhere, to the faceplate of each amplifier to indicate its function.
- I. Metal Work
1. All metal work shall be manufactured to a minimal dimensional tolerance of 0.63 mm (0.025 inches). All edges shall be smooth and free from burrs and other imperfections and shall have a minimum 0.005 inch radius. After manufacture all panels shall have a permanent finish applied which is equal to or better than baked enamel and to the satisfaction of the Architect. Black anodized aluminum is acceptable. Finished panel surfaces shall be free of scratches, nicks, gouges, and dents.
 2. All connector panels will be black unless approved otherwise.
 3. All aluminum panels shall be 0.125 inch stock. Anodized finishes shall be vertically brushed. All single, dual, and triple gang plates shall have the same finish as the panels, except 70.7V attenuator plates which shall be vertically brushed stainless steel.
- J. Fasteners
1. All exposed screws, such as rack and panel mounting hardware, shall be of quality finish, such as stainless steel or nickel plate. Standard Zinc plating is unacceptable. The fasteners shall be of premium grade Philips, Robertson, hex (Allen) head fasteners only. Black oxide finish is preferred. Nylon washers of equal color shall be used to protect the front face of all rack-mounted equipment.
- K. Connector Mounting
1. XLR connectors shall be inserted into panels from the rear. Ensure that labeling strips do not interfere with operation of the connector release mechanisms. Holes shall be sized to suit male or female shell interchangeably.
 2. On a given panel, all XLR latches shall be oriented to the top or to the left, as required.
 3. On a given panel, all speaker connectors shall be oriented with the large key up.

L. Multipin Connectors

1. All multipin connectors specified herein shall include a protective cap to protect the connector when not in use. Each cap shall be affixed to the same panel as the connector with a flexible chain. The chain shall not share fasteners with those used to mount the connector to the panel.
2. Where two mated multipin contacts are used both contacts shall be of the same material.
3. All inline multipin connectors shall contain an integrated cable strain relief.

M. Wireless Systems

1. The AV Contractor is responsible for the successful implementation of wireless systems specified herein.
2. The AV Contractor shall ensure that all RF systems whether part of a single system or multiple systems shall operate simultaneously without any system having an effect on an others performance. This includes both performance and communication systems.
3. The AV Contractor shall ensure that all connections and RF cables meet or exceed the manufacturer's recommendations.
4. All wireless antenna systems shall be tuned to the operating frequencies of the devices to which they are connected.
5. The AV Contractor shall ensure all devices in the RF signal path are tuned to the operating band for which they shall be used.
6. The AV Contractor shall consult with the manufacturer and provide a site survey to determine the best operating frequency range(s) for the facility. This information shall be documented and forwarded to the Systems Engineer prior to commissioning.

N. Power

1. Although all AC power cable and wiring installation on site is not the responsibility of the AV Contractor, the AV Contractor must verify that it is serving the needs of the systems and report any concerns to the Systems Engineer prior to the final acceptance testing.
2. The rack(s) shall be wired to dedicated AC circuits supplied by others for this purpose.
3. AC power distribution within the racks is the responsibility of the AV Contractor. In the case of fixed racks, this distribution shall be accomplished by means of junction boxes for supply termination and plug strips such as Wiremold, which shall be free of switches, fuses and circuit breakers (as found on some power bars, for example). AC circuits will be exclusively switched and protected by the AC Breaker in the panelboard serving the rack.
4. All power cords of rack-mounted equipment shall be neatly bundled so that the plug can be immediately associated with a particular piece of equipment. If this is not possible, tag the plug to identify the equipment.

O. Grounding

1. It is imperative that the grounding methodology adopted be consistent throughout the entire installation.
2. Others shall permanently bond all conduits containing audio and visual systems wiring to the electrical safety ground.
3. All shielded signal cables to have their shields isolated from both the conduit system and any other shielded cables. Unless otherwise specified, shields shall be continuous from source to input points. Line level cable shields shall be connected at output (source) end only, with shields lifted at the input (load). Microphone wiring shall have continuous shields from the microphone outlet to the microphone patching point and, if passed through a normal jack, to a console

microphone input, continuous to that point. This is to provide a safety ground for microphones and other equipment that users may come in contact with. No "doubling up" of ground points on multi-pin connectors or terminal blocks shall be allowed. Pin 1 on XLR type connectors shall not be connected to the connector case. Tie-line patches shall have continuous shield connections from one patch to another, with no permanent connection to the chassis ground.

4. All racks shall be isolated from conduit, building steel and all other conducting elements. Racks shall be grounded only by the isolated ground wire, which accompanies the power wiring.
5. All portable electronic equipment will exclusively receive its technical ground via the isolated equipment ground conductor run to all AC outlets.

P. Rigging

1. Suspend all system elements, as required, using load-rated metallic fittings, to achieve a designed load safety factor of eight. All fasteners shall be minimum grade eight steel.
2. All custom-built rigging fixtures used for overhead suspension shall be stamped by a structural Engineer having jurisdiction in the province of that installation.
3. Provide review drawings detailing proposed suspension methods.

3.5 TESTING AND ADJUSTMENTS

A. General

1. The intent of tests performed is to ensure that a fully functional and operational system is delivered to the client, which reflects best industry practices. To this end we supply this document as a guideline. It is not the intention of the Systems Engineer to direct the AV Contractor to verify all manufacturers' performance specifications on an individual component level unless it is a necessary process to identify and resolve a fault in the system. The Systems Engineer will carry out system performance verification as part of the commissioning process using a random check method. All test set-ups and methods employed by the AV Contractor must be reproducible.
2. These adjustments and tests are to be completed by the AV Contractor using test equipment provided by the AV Contractor at his or her expense.
3. The Systems Engineer may elect to perform additional testing during the system commissioning, with the assistance of the AV Contractor.
4. Allow three days on site, with two technicians equipped with necessary tools and test equipment to adjust audio systems at the direction of the Systems Engineer.

B. Test Equipment

1. The AV Contractor shall have as a minimum the following test equipment available on-site during testing and performance acceptance:
 - a. Sound-level meter (peak and average reading) c/w calibrated microphone and calibrator.
 - b. Low distortion audio signal generator capable of sine wave, square wave, swept sine and pink noise output. Include a complete selection of generator output to standard audio adapters.
 - c. Digital dual trace oscilloscope, minimum 20 MHz; with selection of audio-to-BNC adapters and proper test probes in good working condition.
 - d. High quality VOM capable of accurate AC measurement to 10 KHz.
 - e. Impedance measurement device with digital display such as Gold Line ZM-1.
 - f. CD player (includes cables and audio interface adapters).
 - g. Portable Random-noise generator.

- h. Systems Engineer will require a Dual Channel FFT measurement system such as EAW SmaartLive® or equivalent with all necessary interface electronics, adapters and cables. System should include the computer and measurement microphones with stand(s). During testing the AV Contractor shall have on hand at least one technician with a proficient understanding of the measurement equipment used. Other measurement methods will not be acceptable.
 - i. "Pulse" type phase checker generator/receiver set.
 - j. Include all necessary cables and specialty adapters.
 - 2. Non-professional test equipment or "home-built kit" gear shall not be acceptable.
- C. Documentation
 - 1. As part of the shop-drawing package, submit forms, having the form of a checklist, of the testing activities to be undertaken for review and approval by the Consultant.
 - 2. Prior to acceptance testing, forward to the Consultant a complete report on all testing specified in this section and referenced to it by section number. The report shall indicate that the systems conform to this specification and that the installation is complete in all details and is ready for inspection. The Contractor's Installation Supervisor shall sign the report.
 - 3. At the time of submitting the test report, submit a list of equipment to be used on-site during system commissioning for the use of the Consultant and the Contractor.
 - 4. Supply a list of all equipment in a tabular format that shall include model, manufacturer, serial number, and location installed.
 - 5. Test all wiring for continuity as well as shorts between conductors and shields. These tests shall also confirm isolation between all conductors, including shields and their associated back boxes or conduit systems through which they pass.
 - 6. Ensure all industry standard connections and wire color codes are followed.
 - 7. Test all wiring in raceway and conduits. Test results shall be documented using a report format based on project cable run lists.
 - 8. Each cable must be accurately documented, and the Quality Control Technician is to initial the report for each area of testing. Submit photocopies of the resulting document as part of the test report.
 - 9. Equipment that combines test functions in one sequence may be used. However, these devices must have the ability to test and display complete isolation as described.
- D. Testing of Power, Cable Systems, and Isolated Ground Integrity
 - 1. The Contractor is responsible for ensuring the Electrical Contractor has installed a tested fully functioning electrical system. Once the Electrical Contractor has performed their system tests and notified the Contractor in writing that the electrical system is ready for use, verify Technical Power System ground integrity.
 - 2. THESE TESTS MUST BE PERFORMED BEFORE EQUIPMENT IS CONNECTED and POWER APPLIED.
 - 3. Test all AC outlets for correct phase, neutral and ground wiring.
 - 4. With power removed from racks and system, MAINS POWER SWITCHED OFF AND LOCKED DOWN, perform a ground isolation test to verify isolated ground system integrity.
 - 5. Test each wire in raceway, conduit within racks, and document results using a report format as described previously. Technician is to initial chart while testing. Submit photocopies of the resulting document as part of the test report.

E. Audio Systems

1. All testing of loudspeakers to be installed overhead should be tested thoroughly prior to installation. It is important that all rigging systems are inspected for structural integrity and that all fasteners are secured. Once installed, the loudspeaker will again need to be tested for proper polarity.
2. Verify that all audio systems are free of audible hums, buzzes, transient oscillations, clicks, thumps or other distortions in all configurations and phases of operation. Correct all deficiencies.
3. An oscilloscope with minimum bandwidth of 20 MHz and loudspeaker monitor shall be used to verify that the systems' outputs are free of spurious oscillation and RF pick-up. This shall be done at various lighting dimmer settings in each room.
4. Perform and document polarity testing to ensure that all portions of the audio system, including all microphone and tie-lines, loose cables, wiring, loudspeakers, loudspeaker wiring and cables are in-polarity.
5. Using broadband music, drive each audio system to one third of the rated output for 1 hour and ensure that the equipment ventilation is adequate to prevent front panels from becoming too hot to touch.
6. Using music, drive each system to its maximum long-term sound pressure level and eliminate any buzzing, audible distortion, rattles and/or other undesirable noises. Repeat this procedure but substituting a slow sine wave sweep from 20 to 8000 Hz at about 15 dB below system rated output.
7. Adjust audio systems at the direction of the Systems Engineer.
8. Adjust gain of line level systems components to nominal unity. Assume console output to be +4dB. Using pink noise and dual channel FFT analyzer with calibrated microphone(s), or other approved measurement system, equalize the sound reinforcement system to flat, within the nominal flat frequency band of the loudspeaker system. Optimize the signal processing and amplifier gains for best system signal-to-noise ratio and consistent amplitude throughout the audience seating areas.
9. To ensure proper gain structures throughout the system, perform an end-to-end system test with amplifiers turned off. Use an oscilloscope to measure the max output of the first gain stage(s) and compare those results with the final gain stage at the input of the amplifiers. Ensure that no distortion is introduced into the signal path at maximum levels.

F. Recording Devices

1. It is the AV Contractor's responsibility to ensure all recording devices are operating properly, free of noise, and perform to specification.
2. The AV Contractor shall perform recording and playback on all channels of all recorders. To confirm proper alignment and calibration the AV Contractor shall playback material recorded on similar machines other than the one under test and ensure the signal is free from distortion and dropouts. This test may be performed by listening to manufacturers test medium.

G. Wireless Systems

1. Verify wireless microphones (if specified) are free of drop out and interference within the intended areas of operation. Change frequencies and/or relocate transmitters/antennas if necessary to correct such problems.

H. Testing Control and Switching Systems

1. Verify each path of the switching and muting equipment. Verify logic functions.

2. Confirm communication and control functions between panels and switchboards for all controllable devices and sub systems.
 3. Verify all camera lens and pan/tilt remote control functions.
 4. Confirm software operational logic is as expected.
- I. Testing Video System
1. Test Equipment Required:
 - a. Waveform monitor
 - b. Test signal generator
 - c. Cable continuity meter
 - d. Multimeter
 2. Check all video lines (including trunks) for continuity and shield integrity and confirm end-to-end specifications of typical paths.
 3. Perform equipment alignment and timing calibration.
 4. Ensure that all cables that are part of a set of analogue component video signals (such as RGB or RGBHV) are of the same electrical length.
 5. Optimize and align viewing characteristics of monitors, projectors, and screens.
 - a. Use a color bar test signal as a source for NTSC video.
 6. Check and adjust distribution amplifiers gain and cable length equalization.
 - a. Use a multiburst test signal as a source. Measure gain and frequency response on a Waveform Monitor; adjust video DA gain to unity and cable equalization for a flat frequency response to 6MHz at desired distance.
 7. Configure all switchers and controls with basic operational set-ups. Confirm switcher continuity by testing path and switching performance from all inputs to one output, then from one output to all inputs.
 8. Perform any other tests and adjustments recommended by the equipment manufacturers to optimize the overall performance.
 9. Perform end-to-end tests on several typical paths.
 10. Check all paths for differential gain and differential phase.
 11. Document all tests performed with results, identifying signal paths, test signals and test conditions etc. to ensure repeatability of future tests.
- J. Testing CCD Color Cameras
1. Test video levels.
 2. Perform white and black balance and all other manufacturer recommended set-up procedures.
 3. Perform all manufacturer recommended adjustments to optimize picture quality.
 4. Verify PTZ operation, where provided.
- K. Testing RF Systems
1. Check all RF lines for continuity and shield integrity and confirm end-to-end specifications of typical paths.
 2. Test RF transmission levels.
 - a. Adjust all Modulators RF outputs to their nominal level (+60dBmV typical).
 - b. Terminate all unused RF Splitter outputs into 75-Ohm.
 - c. RF drops (TV Receiver locations) should read 0 to 10dBmV. Adjust all RF Amplifiers' gain and respective attenuation pads accordingly.

3. Test complete RF systems with all other known local RF transmission systems operating. Check for cross talk and interference between systems.
 4. Verify that a video signal, with associated audio, can be modulated at all the frequencies selected on the modulator.
 5. Verify picture quality at each drop point by connecting a TV receiver and observing the picture.
 6. Optimize and confirm alignment.
 7. Confirm all patch points.
 8. Perform any other tests and adjustments recommended by the equipment manufacturers to optimize the overall performance.
- L. Test Distributed Audio System
1. Remove distributed audio line from output of distribution amplifiers.
 2. Connect an impedance meter (Gold Line ZM-1) to the distributed loudspeaker line.
 3. Using the meter, verify the total load of the distributed line. The line load shall not exceed the intended design limits.
 4. The AV Contractor shall include test results in the system manual.
- M. Digital Audio Signal Systems
1. Test Digital Audio signals for proper operation between devices. Ensure no additional noise is introduced into the analogue audio and digital signal paths when all devices are interconnected for normal operation.
 2. Ensure all signals throughout the digital audio path are functioning at designed levels. Unless otherwise specified all DSP components shall function at +4dbu nominal with 0db FS at +22dbu.
- N. Control Application
1. Verify operation of control system.
 2. Ensure correct operation of all system presets.
 3. Test all interface controls for proper operation.
 4. Submit a copy of the control or DSP program and operator GUI to Systems Engineer prior to commissioning.
- O. LAN
1. Verify all LAN connections and paths using best industry practices. Verify end-to-end performance with industry standard LAN test equipment.
 2. All LAN cables must be point to point without splices.
- P. Fibre Systems (Where specified)
1. Verify all fibre connections and paths using best industry practices.
 2. Verify end-to-end optical performance with industry standard optical test equipment.
 3. All fibres must be point to point without splices.
 4. All fibres shall be terminated and panel mounted.
- 3.6 FIELD QUALITY CONTROL
- A. System Commissioning:
1. At the time of commissioning, if upon arrival at site after notification, the system is found to be incomplete, the Contractor shall reimburse expenses including labor, travel, hotel, and meals.

2. Schedule of Equipment

3. BASE BID:

Band Room

Quantity	Use	Make	Model
1 lot	Plates and panels w/tie line infrastructure	Custom	
1 lot	Relocate existing 24 analog lines		

Glee Club

Quantity	Use	Make	Model
1 System	Electronic Acoustic Enhancement System complete with microphones, loudspeakers, processing and control		
1 lot	Plates and panels w/tie line infrastructure	Custom	
1 year	Service and Maintenance contract		

Control Room

Quantity	Use	Make	Model
1 lot	Relocate existing connection plate		

AV Rack Room

Quantity	Use	Make	Model
2	CAT6 Patchbay 48 port	Bitree	
1	24 port switches with POE		
1	XLR Patchbay	Custom	
1	BNC Coax Patchbay	Bitree	
3	Power/Rack lights	Furman	PL8-C
3	Power Conditioner	Furman	P2400 IT
1 lot	Processing gear for EAS	Per Manufacturer	
1 lot	Amplifiers for EAS	Per Manufacturer	
3	44RU pull out racks	Middle Atlantic	

ADD/ALTERNATE

Band Room

Quantity	Use	Make	Model
1	Projector 12K Laser	Panasonic	PTRZ120
1	Projector lens	Panasonic	ETDLE020

1	Projector mount	Panasonic	ET-PKD 120H
1	Elec Proj Screen 8.75'w x 14'	Draper	Acumen XL E
1	Lectern	Avin ED	CAHB-KB-ADA
1	Control system	Extron	MLC Plus 100
1	Amplifier	Extron	XPA-2001
1	Video switch	Extron	IN1606
1	Input plate	Extron	Cable Cubby UT with modules
2	Video Receiver	Extron	DTP HDMI 4K 230 Rx
1	Video Transmitter	Extron	DTP T HD2 4K 230
1	Camera USB	Vaddio	Intellishot
1	USB Extender	Extron	USB EXT DM Remote
1	USB Extender	Extron	USB EXT DM Local
2	Loudspeakers	Extron	(white) SI-3
1	Assisted listening system	Listen	LKS-4-A1

Glee Club

Quantity	Use	Make	Model
1	Projector 12K Laser	Panasonic	PTRZ120
1	Projector lens	Panasonic	ETDLE020
1	Projector mount	Panasonic	ET-PKD 120H
1	Elec Proj Screen 8.75'w x 14'	Draper	Acumen XL E
1	Lectern	Avin ED	CAHB-KB-ADA
1	Control system	Extron	MLC Plus 100
1	Amplifier	Extron	XPA-2001
1	Video switch	Extron	IN1606
1	Input plate	Extron	Cable Cubby UT with modules
2	Video Receiver	Extron	DTP HDMI 4K 230 Rx
1	Video Transmitter	Extron	DTP T HD2 4K 230
1	Camera USB	Vaddio	Intellishot
1	USB Extender	Extron	USB EXT DM Remote
1	USB Extender	Extron	USB EXT DM Local
2	Loudspeakers	Extron	(white) SI-3
1	Assisted listening system	Listen	LKS-4-A1

Control Room

Quantity	Use	Make	Model
1	Video Transmitter	Extron	DTP2 T 204

END OF SECTION 274116.61

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INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT.DOCX

SECTION 312500 – EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Erosion and Sediment Control measures shall comply with the requirements of the New York State Department of Environmental Conservation. Additional control measures are described on Contract Drawings
- C. Project Specifications:
 - 1. Section 02 10 00 – Protection of Existing Utilities
 - 2. Section 31 90 00 – Trench Excavation and Backfill
- D. Project Documents:
 - 1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide erosion and sedimentation controls in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
 - 1. Installing and maintaining temporary and permanent erosion control systems.

1.4 PROJECT CONDITIONS

- A. Work of this section, as shown or specified, shall provide erosion and sediment control in accordance with the requirements of the New York State Department of Environmental Conservation.

1.5 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Engineer.
- B. The Contractor must provide the following submittals to the Engineer, Architect, and Owner or Owner's Representative for approval prior to purchase of materials:

1. Material Certificates: Submit materials certificate to the Engineer and Owner or Owner's Representative which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.
2. Prior to the commencement of work, the Contractor shall submit to the Owner record copies of all required permits and certificates obtained for the work in this section. The Contractor shall incur all fees and other requirements associated with obtaining the required permits and certificates.
3. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.
4. Product Data: Submit Manufacturer's application and installation instructions for proprietary materials and items as requested by the engineer.

1.6 QUALITY ASSURANCE

- A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places, and the sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged beyond repair during delivery will be rejected and, if already installed, shall be repaired to the Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.
- B. Perform work specified herein and shown on the Contract Drawings in compliance with applicable requirements of the New York State Building Code and requirements of all state and local authorities, and utility companies having jurisdiction.

1.7 CONTRACTOR RESPONSIBILITIES

- A. Contractor is responsible for coordinating this work with other trades on-site.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.

1.9 PERMITS AND APPROVALS

- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work authorized by the permit.
- B. REFERENCE STANDARDS
- C. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- D. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
 1. EPA Standard 832/R-92-005, Chapter 3 Sediment and Erosion Control
 2. NYSDEC Standards and Specifications for Erosion and Sediment Control 2012, or latest revision

3. EPA 2003 Construction General Permit, outlining a set of provisions construction operations must follow to comply with NPDES stormwater regulations, regardless of project site size
4. United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.
5. All state and local standards and codes applicable to the Project.

E. Acronyms and Abbreviations

1. BMP: Best Management Practice
2. EPA: United States Environmental Protection Agency
3. ESC: Erosion and Sedimentation Control

F. Definitions:

1. Controls: Measures employed to minimize erosion and sedimentation due to construction activities.
2. Erosion: A natural process involving water, wind or ice that results in the loosening and removal of soil and rock. Human activities, such as site disturbance during construction, accelerate the natural process.
3. On-site Pollution: Sources of site pollution include, but are not limited to: oil dripping from vehicles; improperly disposed material scraps and delivery wrapping; concrete wash-water; lunch trash from workers on the site.
4. Sedimentation: A natural process involving water, wind or ice that results in the deposit of soil and rock. Sedimentation during construction limits the passage of water, potentially causing: backflow; flooding of streets; overflow of downstream drainage; damage to off-site locations due to deposit of sedimentation.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. The Contractor shall protect adjacent properties and waterways from erosion and sediment damage throughout construction in accordance with NYSDEC.

1.11 EXTRA MATERIALS

- A. Extra materials should be kept on site at all times. Should any erosion and sediment controls be deemed deficient, the contractor must repair and/or replace.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Catch basin and trench drain erosion control – as shown on contract documents

- B. Catch Basin Silt Sack

1. The silt sack shall be an open-top geotextile bag that can be suspended from a catch basin grate. The suspended solids are allowed to settle out of the slowed flow and are captured by the sack prior to entering the inlet. There shall be two dump straps attached at the bottom of the sack to facilitate the emptying and cleaning of the sack and there shall be two lifting hoops as an integral part of the system to be used to lift the sack from the catch basin.
2. The geotextile sack shall be constructed with high-tenacity, monofilament, polypropylene yarns which are woven into a stable network such that the yarns retain their relative position. The geotextile shall be resistant to ultraviolet degradation and to biological and chemical environments normally found in soils. Acceptable materials are "Dandy Sack™" Mirafi, "Silt

Sack® The BMP Store or "StormSok" Fabco or equivalent Orange Construction Fencing
(placement location to be coordinated with the owner)

PART 3 – EXECUTION

3.1 PREPARATION

- A. Review site conditions with Owner and Contract Drawings prior to the commencement of earth moving activities/excavation.
- B. Notify the Owner prior to the commencement of Work. Any proposed deviations from the specifications must be submitted to the Engineer in writing 72 hours prior to commencing work.
- C. By beginning Work, the site conditions are accepted and corrections to encountered unsatisfactory conditions will occur at no additional cost to the Owner.
- D. All erosion and sediment controls shall be installed prior to land disturbing activities or as necessary to control erosion from land disturbing activities. Comply with all applicable standards for Soil Erosion and Sediment Control in New York State.
- E. The Contractor will be responsible for the proper construction, stabilization, and maintenance of all temporary and permanent erosion and sedimentation control measures and related items.
- F. All erosion and sediment controls shall remain in place until the tributary area to the control is completely stabilized. All controls shall be checked daily and after storm events to ensure they are in proper working order.
- G. The Contractor shall replace at no extra payment any control device that is not functioning properly as directed by contracting officer or authorized regulatory personnel.
- H. The Contractor shall implement dust control measures during construction. Contractor to minimize dust clouds by watering down construction area or other approved methods as required.
- I. Inlet protection shall be installed on all new catch basins immediately upon construction.
- J. All construction vehicles hauling materials either into or out of the construction area shall have a secured tarp over materials to prevent sediment pollution of public roadways.
- K. Contractor shall provide a rock construction entrance and construction vehicle wash down area at all egress points from un-stabilized areas to prevent tracking mud onto public sidewalks and roadways.
- L. Contractor shall field verify quantity of all drains and install protection for each.

2.2 MAINTENANCE AND REMOVALS

- A. Maintain erosion and sediment controls in good working order, using best management practices.
- B. Soil sediment removed from any temporary control measure during regular maintenance shall be treated as site earthwork and returned to site or disposed of per contract documents.
- C. Erosion and sediment controls shall not be removed until the site has been adequately stabilized, or as

otherwise directed by the Engineer.

- D. Stabilization shall be defined as a uniform, 70% vegetative cover for landscaped areas. Stabilization shall be defined as installation of stone subbase in pavement and slab areas.

2.3 STABILIZED CONSTRUCTION ACCESS – INSTALLATION AND MAINTANANCE

- A. Install stabilized construction entrances at any point where traffic will be entering or leaving a construction site to or from a public-right-of-way, street, alley, sidewalk, or parking area.
- B. Stabilized construction entrance stone thickness shall be a minimum of 6-inches (15-centimeters).
- C. The stabilized construction access shall be twelve feet minimum but not less than the full width of points of where ingress or egress occurs. The stabilized construction access shall be a minimum of 24-inches (61-centimeters) if there is only one entrance to the site.
- D. The length of the stabilized construction access shall be 50-feet (15.2-meters) minimum.
- E. Geotextile shall be placed over the entire area to be covered with aggregate.
- F. Piping of surface water under entrance shall be provided as required. If piping is impossible, a mountable berm with 5:1 slopes will be permitted.
- G. The entrance shall be maintained in a condition which will prevent tracking of sediment onto public-right-of-way or streets. This may require periodic top dressing with additional aggregate. All sediment spilled, dropped, or washed onto public right-of-way must be removed immediately.
- H. When necessary, wheels must be cleaned to remove sediment prior to entrance onto public right-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment trapping device. All sediment shall be prevented from entering storm drains, ditches and watercourses.

2.4 INLET PROTECTION SILT SACK– INSTALLATION AND MAINTANANCE

- A. Silt sacks shall be installed prior to start of construction activity on site and shall not be removed until final acceptance of work, unless otherwise directed by the engineer. The Contractor shall remove the grate of the catch basin and install the sack in accordance with the Manufacturer's written instruction. The grate shall be set back into place after the sack is installed with the lifting straps outside or on top of the grate.
- B. The contractor shall remove all accumulated sediment and debris from the vicinity of the catch basin after each storm event and as directed by the Resident Engineer. Where the sack is more than one-third (1/3) full of sediment, the sack shall be cleaned by lifting the unit out of the catch basin and emptying the contents to an area within the Contract limit line as directed by the engineer.
- C. The silt sack shall be maintained in working condition for the life of the project. If the sack breaks, is damaged or ceases to function during the construction period, the Contractor shall remove and replace it with a new one at no additional cost.

2.5 MAINTENANCE AND REMOVALS

- A. Maintain erosion and sediment controls in good working order, using best management practices.

- B. Soil sediment removed from any temporary control measure during regular maintenance shall be treated as site earthwork and returned to site or disposed of per contract documents.
- C. Erosion and sediment controls shall not be removed until the site has been adequately stabilized, or as otherwise directed by the Engineer.
- D. Stabilization shall be defined as a uniform, 70% vegetative cover for landscaped areas. Stabilization shall be defined as installation of stone subbase in pavement and slab areas.

END OF SECTION 312500

SECTION 319000 – TRENCH EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Project Specifications:
 - 1. Section 02 01 10 – Maintenance of Existing Conditions
 - 2. Section 02 10 00 - Protection of Existing Utilities
 - 3. Section 31 25 00 – Erosion and Sedimentation Controls
 - 4. Section 32 13 13 – On-site Concrete Paving
 - 5. Section 32 12 16 - On-site Asphalt Paving
 - 6. Section 33 40 00 - Storm Drainage Utilities
- C. Project Documents:
 - 1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide trench excavation and backfill in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
 - 1. Excavating trenches for the installation of utilities.
 - 2. Backfilling trench with bedding aggregate as specified and finish filling trenches with suitable material to proposed subgrade.
 - 3. Compacting subgrade, bedding, and backfill materials in an acceptable manner.
 - 4. Compliance with all environmental and health and safety regulations.

1.4 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Engineer. The Contractor shall contact all utility companies and West Point Department of Public Works and identify any requirements. Contractor shall provide written confirmation of the status of all utility construction to the Owner at the time of the preconstruction conference or no later than 30 days following the project possession date.
- B. The Contractor must provide the following submittals to the Engineer, Architect, and Owner or Owner's Representative for approval prior to purchase of materials:

1. Submit a sample of each type of offsite fill and/or bedding material that is to be used in backfilling.
2. Material Certificates: Submit materials certificate to the Owner or Owner's Representative which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.
3. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.

1.5 CONTRACTOR RESPONSIBILITIES

- A. Contractor is responsible for coordinating this work with other trades on-site.

1.6 PERMITS AND APPROVALS

Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work authorized by the permit.

1.7 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
 1. American Society for Testing and Materials (ASTM) Latest Edition
 - a. ASTM D 422 - Method for Particle Size Analysis
 - b. ASTM D 698 - Test of Moisture Density Relations of Soils - Standard Proctor Method
 - c. ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - d. ASTM D 2216 - Test Method for Laboratory Determination of Water (Moisture) Content of Rock and Soil.
 - e. ASTM D 2487 - Test Method for Classification of Soils for Engineering Purposes.
 - f. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 - g. ASTM D 3017 - Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth)
 - h. ASTM D 4318 - Test for Plastic Limit, Liquid Limit, & Plasticity Index of Soils
 2. American Association of State Highway and Transportation Officials (AASHTO) Latest Edition
 - a. T88 Mechanical Analysis of Soils

1.8 DEFINITIONS

- A. Bedding: Fill placed under, around and up to the spring line of the pipe, prior to subsequent backfill operations, unless otherwise indicated on the Construction Drawings.
- B. Backfill: Fill placed from the spring line of the pipe to proposed subgrade elevation.
- C. Spring line: The horizontal midpoint of a pipe.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Stone Bedding Material: AASHTO No. 57 processed sand and gravel free from debris, clay lumps, organic, or other deleterious material, and complying with following gradation requirements:

<u>U. S. Sieve Size</u>	<u>Percent Passing (by weight)</u>
1-1/2 Inch	100
1 Inch	95-100
1/2 Inch	25-60
No. 4	0-10
No. 8	0-5

- B. Sand Bedding Material: Natural or processed sand free from debris, clay lumps, organic, or other deleterious material; and complying with the following gradation requirements:

<u>U.S. Sieve Size</u>	<u>Percent Passing (by weight)</u>
3/4 Inch	100
No. 4	95-100
No. 16	45-85
No. 50	3-29
No. 100	0-10

- C. General Fill: Shall have no more than 20% by weight of stones or masonry debris, containing no stones or other materials greater than 4 inches in any dimension and contain less than 20% by weight materials finer than No. 200 mesh sieve.
- D. Fill for utility trenches shall meet the criteria given for structural fill and shall not contain sharp, angular pieces and pieces larger than 2 inches in any dimension.
- E. Before bringing any fill to the site, the Contractor shall submit the source for approval by the Owner's Engineer.
- F. All fill materials shall be free from wood, debris, combustible materials, organics, and vegetable matter or any material subject to decay or disintegration.
- G. The use of recycled concrete aggregate (RCA) is prohibited.

PART 3 - EXECUTION

3.1 GENERAL SITE PREPARATION

- A. Set all lines, elevations, and grades for utility and drainage system work and maintain for the duration of work. Provide careful maintenance of benchmarks, property corners, monuments, or other reference points.
- B. Protect and maintain in operating condition, existing utilities encountered during utility installation. Repair any damage to surface or subsurface improvements shown on Drawings.

- C. Install dewatering systems that will be required to construct the proposed utilities to the design elevations and using the methods described herein. Water pumped out of excavations shall be disposed of on-site, and will not be discharged directly to the storm drainage system.
- D. Over excavate and properly prepare areas of subgrade that are not capable of supporting the proposed systems. These areas are to be stabilized by using acceptable backfill materials and/or additional bedding material placed and compacted as specified to the satisfaction of the Geotechnical Engineer.

3.2 EXCAVATION

- A. Contact local utility companies before excavation begins. Dig trenches at proper width and depth for laying pipe, conduit, or cable and in accordance with utility company requirements. Cut trench banks for safety and remove stones as necessary to avoid point bearing.
- B. All trench excavation side walls shall be sloped, shored, sheeted, braced or otherwise supported by means of sufficient strength to protect the workmen within them in accordance with the applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and Health Administration (OSHA), and by local ordinances. Lateral travel distance to an exit ladder or steps shall not be greater than 25 feet (7.6 meters) in trenches 4 feet (1.2 meters) or deeper.
- C. Trench width requirements below the top of the pipe shall not be less than 12" (30-cm) nor more than 18" (46-cm) wider than outside surface of any pipe or conduit that is to be installed. All other trench width requirements for pipe, conduit, or cable shall be the minimum practical width that will allow for proper compaction of trench backfill and satisfy safety and utility company regulations.
- D. Accurately grade trench bottom to an elevation 6 inches (15 centimeters) below the pipe, as per bedding details in construction drawings. Provide uniform bearing and support for each section of pipe on bedding aggregate at every point along the entire length, except where necessary to excavate for bell holes, pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make the joint connection properly.
- E. During excavation, stockpile excavated material suitable for backfilling in an orderly manner far enough from the trench to avoid overloading, slides, or cave-ins.
- F. Remove excavated materials from the site which are not suitable for backfill.
- G. Any abandoned structures utilities or debris discovered during excavation shall be removed and disposed of, or capped.
- H. Utility alignments have been designed to avoid expected obstructions wherever possible. If unanticipated significant obstructions are encountered during utility installation work immediately notify the Owner and Engineer.
- I. Prevent surface water from flowing into trenches or other excavations by temporary grading or by other methods, as required. Remove accumulated water in trenches or other excavations by pumping or other acceptable methods. Water shall not be directly pumped to the sewer system.
- J. Utility installation shall meet the following minimum pipe installation depths, or applicable codes and ordinances, measured from finished grade or the paved surface.

1. Storm Sewer: Elevations, and grades as shown on Construction Drawings.

3.3 FILL PLACEMENT, GRADING, AND COMPACTION

A. General

1. Do not commence filling and backfilling operations until construction below finish grade has been approved, underground utilities and mechanical items inspected and tested, forms removed, waterproofing or damp-proofing and other improvements installed, trash and debris removed, and temporary and permanent bracing installed.
2. Do not commence backfilling, filling and grading until existing subgrade has been compacted.
3. Fill all excavations, backfill against all walls, and do all filling and grading necessary to bring the surfaces to the level required.
4. No fill material shall be placed on areas where free water is standing, or frozen subsoil area, or on surface which have not been approved for fill placement by the Geotechnical Engineer.
5. Do not backfill against concrete elements until the concrete has obtained its specified compressive strength.
6. Perform backfilling around foundation walls when the first floor provides sufficient bracing to withstand the backfill pressure. All other fill, backfill, and rolling to approximately finished grades shall then be completed.
7. Take particular care when rolling over areas where trenches or other excavations have been made and backfilled.
8. Fill voids caused by the removal of below grade improvements.
9. Grade bottoms of pavements and area way bottoms toward sediment pits or catch basins to maintain uniform thickness of the slabs.

B. Grading

1. Prior to placing fill or backfill in any area, grading is to be performed as required to provide for drainage. Ditching or filling around the area will be performed to intercept or divert all surface water. Within the area the ground which fill is to be placed will be graded so as to provide for unobstructed drainage from every point to a sump or other disposal point.
2. On completion of grading as specified above, closely examine to determine whether excessive wetness, springs, or other seepage of water can be observed at any point. If such conditions exist, positive drainage in suitable form, such as french drains or tilling, must be provided before placement of fill is undertaken.

C. Placement and Compaction of Controlled Fill and Backfill

1. Placement

- a. General: Begin fill and backfilling in the lowest section of the area. Spread material evenly by mechanical equipment or by manual means above the approved compacted subgrade in lifts not exceeding 10 to 12 inches for material compacted by heavy machinery and 4 inches for material compacted by hand tamping.

Build layers as horizontally as practical to prevent thickness of lift from exceeding that specified but provide with sufficient longitudinal and transverse slope to provide for runoff of surface water from every point.

- b. Moisture Control: The moisture-density curve for the fill use shall be supplied to the Contractor as a guide in controlling moisture to achieve the required degree of compaction. If, in the opinion of the Engineer, fill material becomes too wet for the required compaction, the fill shall be dried by a method approved by the Engineer prior to commencing or continuing compaction operations. Likewise, if, in the opinion of the Engineer, the fill material becomes too dry for the required compaction, the fill shall be moistened by a method approved by the Engineer prior to commencing or continuing compaction operations.

- 2. Compaction: Compact each lift to 95% of the maximum dry laboratory density by ASTM D1557. The degree of compaction shall be checked by the Engineer and each successive lift shall not be placed or compacted until the previous lift is inspected and approved by the Engineer. Compact the fill and backfill to elevations and limits shown on Drawings and is subject to final inspection and approval by the Engineer. Extend the compacted fill beyond the berm lines on a slope downward at a maximum slope of two horizontal to one vertical to intersect the approved stripped subgrade. Maintain the fill slopes at all times.
- 3. Drainage During Fill Operation: At all times, maintain and operate proper and adequate surface and subsurface drainage to the satisfaction of the Engineer in order to keep the construction site dry and in such condition that placement and compaction of fill may proceed unhindered by saturation of the area.
- 4. Frost: Do not place fill materials when either the fill materials or the previous lift (or subgrade) on which it is placed is frozen. In the event that any fill which has already been placed on the surface shall become frozen, it shall be scarified and recompact, or removed, to the approval of the Engineer before the next lift is placed. Remove or recompact any soft spots resulting from frost to the satisfaction of the Engineer before new fill is placed.

3.4 CLEANING

- A. The Contractor shall remove all excess material, including earth, rock, and fill, from site and legally dispose of it.
- B. The Contractor shall be responsible for removal of all debris from the site produced by the Work of this Section.
- C. The Contractor shall ensure that the sidewalk and streets adjoining the property are broom cleaned and free of debris, rubbish, trash and obstructions of any kind caused by the Work of this Section.

3.5 EMBEDDED ITEMS

- A. Utility bedding shall be in accordance with this Section.

3.6 MAINTENANCE AND PROTECTION

- A. The Contractor shall protect newly graded areas from erosion and traffic. They shall keep the work area free of trash and debris.
- B. The Contractor shall repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Where completed or compacted areas are disturbed by subsequent construction operations or adverse weather, the Contractor shall scarify surface, reshape, and compact to required density prior to any further construction.
- D. Where settling is measurable or observable at excavated areas during the general project warrantee period, the Contractor shall remove the surface (pavement, or other finish), add backfill material, compact, and replace surface treatment. They shall restore the appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 319000

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SECTION 321216 – ON-SITE ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Project Specifications:
 - 1. Section 02 01 10 – Maintenance of Existing Conditions
 - 2. Section 02 10 00 – Protection of Existing Utilities
 - 3. Section 31 90 00 – Trench Excavation and Backfill for Utilities
- C. Project Documents:
 - 1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide On-site Asphalt Paving in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
 - 1. Asphaltic concrete wearing course.

1.4 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Engineer.
- B. The Contractor must provide the following submittals to the Engineer, Architect, and Owner or Owner's Representative for approval prior to purchase of materials:
 - 1. Material Certificates: Submit materials certificate to the Engineer and Owner or Owner's Representative which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.
 - 2. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.
 - 3. Design Mix: Before any asphaltic concrete paving is constructed, submit actual design mix to the Owner's Representative for review and/or approval. Design mix submittal shall include the

type/name of the mix, gradation analysis, grade of asphalt cement used, sources of all ingredient materials, and percentages by weight and the number of pounds of each of the materials and direct references to the Standard Specifications sections for each material. Mix designs over three (3) years old will not be accepted by the owner.

1.5 QUALITY ASSURANCE

- A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places, and the sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged beyond repair during delivery will be rejected and, if already installed, shall be repaired to the Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.
- B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface of all asphalt shall be dense, close textured and free of blisters, cracks, roughness and exposure of reinforcement.

1.6 CONTRACTOR RESPONSIBILITIES

- A. Contractor is responsible for coordinating this work with other trades on-site.
- B. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.

1.8 PERMITS AND APPROVALS

- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work authorized by the permit.

1.9 PROJECT RECORD DOCUMENTS

- A. Upon completion of the work of this and related sections, the contractor shall provide the Owner with an as-built survey of all new installed asphalt pavements. The data shall include grades, striping, and utilities within limits of work, and shall be tied into established project benchmarks. The survey shall be provided in digital (AutoCAD DWG) and paper formats, and shall be signed and sealed by a New York State Licensed Professional Land Surveyor. This survey may be combined with other as-built survey requirements of site-work items, with the approval of the Owner. Marked-up design plans are not acceptable for the requirements of this section.

1.10 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements

described in the referenced standards shall be deemed mandatory and applicable to the Work.

- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.

1. American Society for Testing Materials (ASTM)
 - a. ASTM D946 – Penetration Graded Asphalt Cement for use in Pavement Construction
 - b. ANSI/ASTM D1557 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 kg) Hammer and 18 inch (457 mm) Drop.
 - c. ASTM D2922 – Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth), Method B (Direct Transmission).
 - d. ASTM D424 – Standard Method of Test for Plastic Limit
 - e. ASTM C33 – Standard Specification for Concrete Aggregates
 - f. ASTM D1559 – Test Method for Resistance of Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
 - g. ASTM D2028 – Standard Specification for Cutback Asphalt (Rapid-Curing Type)
 - h. ASTM D2950 – Density of Bituminous Concrete in Place by Nuclear Methods
 - i. ASTM D2041 – Specific Gravity and Density of Bituminous Paving Mixture, Theoretical Maximum
2. TAI - (The Asphalt Institute) –
 - a. TAIMS-2 Mix Design Methods for Asphalt Concrete and Other Hot Mix Types
 - b. TAI - MS-8 Asphalt Paving Manual
3. United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.

1.11 PERFORMANCE REQUIREMENTS

- A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Weather Limitations: Do not place asphalt pavement top course when ambient air or base surface temperature is less than 40 degrees F (4.4 degrees C), or surface is wet. Asphalt binder course may be placed when ambient air or base surface temperature is above 30 degrees F (-1.1 degrees C) and rising and base is dry.
- B. Apply tack coat when ambient air or base surface temperature is above 50 degrees F (10 degrees C) for 12 hours immediately prior to application. Do not apply when base is wet.

PART 2 - PRODUCTS

2.1 ASPHALT MATERIALS

- A. Asphaltic Concrete Wearing Course
1. Asphaltic concrete wearing course shall consist of a binder mixture and a fine-mix asphaltic concrete surface course mixture in layer thicknesses indicated on Drawing.

2. Asphaltic cement shall comply with the requirements of ASTM D946, except that the ductility test shall be run at 60 degrees Fahrenheit and that the petroleum derivative in the Spot Test with standard naphtha solvent in 24 hours shall be negative. Asphaltic cement shall meet the requirements listed below and shall be either fluxed natural asphalt or residual asphalt derived from the distillation of asphaltic petroleum.

Viscosity Grade	AC-20	
Requirements	Min.	Max.
Viscosity@ 140F(60C), poises	1600	2400
Viscosity@ 275F(135C), Cs.	300 *	-
Penetration, 77F(25C) 100g, 5 sec.	60 *	-
Flash Point, COC, F	450	-
Solubility in trichloroethylene, %	99	-
Test on residue from thin-film oven test (TFOT): Loss on heating, %	-	0.50
Ductility, 60F(15.5C), 5 cm/min., cm.#40	30 *	-
Viscosity Ratio@ 140F(60C), poises after:before TFOT	-	4 *

3. The above requirements denoted with an asterisk (*) may deviate for asphalt cements refined from Domestic Mid-continent, Canadian, or Boscan crudes with prior approval of the Owner's Representative.
4. Sand shall be per NYSDOT Specifications and shall consist of clean, hard, durable, rough-surfaced mineral particles. Sand shall not contain any deleterious substances in excess of that shown in Table 1 of ASTM C33.

B. Asphaltic Concrete Surface Course

1. Coarse aggregate for binder mix shall be AASHTO size #57 stone. Coarse aggregate for fine-mix surface course shall be a AASHTO size #8 stone. NYSDOT Standard Specifications section 401-2, Type 7, Item 403.18.
2. Mineral dust shall be limestone or other approved dust, be thoroughly dry when delivered, be of one grade, and contain no more than 50% free silicon dioxide. Dust shall have a record of satisfactory performance in pavements for not less than three (3) years. Mineral dust shall not be permitted in Binder Mixture.
3. Aggregate within asphaltic concrete mixes shall comply with the following sieve analyses:

Sieve Size	Binder Course		Fine-Mix Surface Course	
	% Passing	Tol.(%)	% Passing	Tol.(%)
1 1/2"	100	-		
1"	95-100	-	100	-

1/2"	70-90	± 6	90-100	-
1/4"	48-74	± 7	65-85	± 7
1/8"	32-62	± 7	36-65	± 7
#20	15-39	± 7	15-39	± 7
#40	8-27	± 7	8-27	± 7
#80	4-16	± 4	4-16	± 4
#200	2-8	± 2	2-6	± 2
Bitumen percent by weight soluble in chloroform	4.5-6.5	± 0.4	5.8-7.0	± 0.4

4. Tack Coat shall be rapid curing liquid asphalt conforming to ASTM D2028 Grade RC-70, and shall be a product of fluxing an asphaltic residuum with a distillate. Liquid asphalt shall be homogeneous and free from water. Homogeneous Asphalt Emulsion Tack Coat conforming to NYSDOT Material Designation 702-90.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify sub-base conditions under provisions of Section 31 90 00
- B. Verify that compacted sub-base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct, including crown and cross slope.

3.2 INGREDIENTS

- A. The asphaltic cement shall be heated in approved receptacles to a temperature between 275 and 325 degrees F (135 and 163 degrees C). It shall be kept uniform in composition and consistency by thorough mixing and agitation. Approved methods of agitation that will not injure the cement shall be used.
- B. The materials comprising the charge for each batch shall be proportioned accurately by weight or by volume. The proportioning apparatus shall be of approved NYSDOT design, kept in good working order and accurate to 0.5 percent. Fluid materials may be measured by approved fluidometers.
- C. When mixed in a batch mixer prior to the addition of the asphaltic cement, the aggregate shall be deposited in the mixer and thoroughly mixed for a period of not less than ten seconds for binder mixture and fifteen seconds for surface mixtures.
- D. Mixing shall be continued until a homogeneous mixture is produced in which all particles of the mineral aggregate are completely coated with asphaltic cement.

3.3 PREPARATION

- A. Saw cut existing pavement to produce a clean, straight edge for new work to meet.
- B. Verify that substrate has been inspected and that substrate is hard, uniform and stable, true to gradients and elevations, and dry prior to any sub base course construction.
- C. Proof roll base material surface to check for areas requiring additional compaction and areas requiring removal and re-compaction.
- D. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving.
- E. Weather limitations:
 - 1. Apply tack coat when ambient temperature is above 40°F (4.4°C), and when temperature has been above 35°F (1.67°C) for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.
 - 2. Construct asphaltic concrete paving when atmospheric temperature is above 40°F (4.4°C).

3.4 TRANSPORTATION

- A. Asphalt mixtures shall be transported to work site in tight vehicles having clean and smooth heated metal beds and protected from weather.
- B. The inside surface of transportation vehicles shall be lightly coated, just before the vehicles are loaded, with either a whitewash of lime and water, soap solutions, or detergents, as approved by the Commissioner. After application, the truck bodies shall be raised for a sufficient time to allow the excess fluid to drain.

3.5 APPLICATION

- A. Tack Coat
 - 1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or Portland cement concrete and surfaces abutting or projecting into asphaltic concrete or into asphaltic concrete pavement.
 - 2. Apply tack coat between each lift or layer of full depth asphaltic concrete and on surface of all such bases where asphaltic concrete paving will be constructed.
 - 3. Apply at minimum rate of 0.10 gallon per square yard of surface.
 - 4. Allow to dry until at proper condition to receive paving.
- B. Asphaltic Concrete Placement
 - 1. Place asphaltic concrete mixture on completed compacted subgrade surface, spread, and strike off. Spread mixture at following minimum temperatures:
 - a. When ambient temperature is between 40°F (4.4°C) and 50°F (10°C), mixture temp. = 285°F (140.6°C)
 - b. When ambient temperature is between 50°F (10°C) and 60°F (15.6°C), mixture temp. = 280°F (137.8°C)
 - c. When ambient temperature is higher than 60°F (15.6°C), mixture temp. = 275°F (135°C)
 - 2. Whenever possible, all pavements shall be spread by a finishing machine; however, inaccessible or irregular areas may be placed by hand methods. The hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated coarse aggregate and rake marks. Rakes and lutes

used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster than can be properly spread. Workers shall not stand on the loose mixture while spreading.

3. Place in typical strips not less than 10' 0" (3.04 m) wide or the full path width, whichever is smaller. Place in strips of equal width for each driving lane. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Any irregularities in the surface of the pavement shall be corrected directly behind the paver. Excess materials forming high spots shall be removed. Indented areas shall be filled with hot mix and smoothed. Casting of mix over such areas will not be permitted.
4. Joints: Make joints between old and new pavements, or between successive days and work in a manner that will provide a continuous bond between adjoining works. Construction joints shall have same texture, density, and smoothness as other sections of asphaltic concrete course. Clean contact surfaces of all joints and apply tack coat.

3.6 ROLLING AND COMPACTION

1. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition.
2. The bituminous concrete pavement shall have a minimum thickness as specified on the Contract Documents and should be compacted to a minimum of 96% of the maximum unit weight as determined by the Marshall Mix Design Procedures in accordance with ASTM D-1559.
3. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
4. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling with hot material.
5. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
6. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
7. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.
8. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 CLEANING

- A. Clean-up and dispose of all surplus or waste material as a result of work of this section. Asphalt Pavement shall be broom cleaned and the surrounding area shall be cleaned of any loose asphalt mix.

3.7 FIELD QUALITY CONTROL

- A. Grade Control: Establish and maintain required lines and elevations.

- B. Temperature: The Owner's Representative shall monitor the asphaltic concrete mixture on the paver immediately prior to spreading asphalt mixture to certify that the minimum temperature requirements of this section are met. Temperature measurement shall be taken on the average of one test per 20 tons of material.
- C. Thickness: In place compacted thickness shall not be less than thickness specified on the drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum 1" (2.54 cm) overlay; or shall be removed and replaced to the proper thickness, at the discretion of the Owner; until specified thickness of the course is met or exceeded at no additional expense to the Owner. Saw cut adjacent pavement to match overlay; "feathering" shall not be permitted.
- D. Surface Smoothness: The Contractor shall perform testing on the finished surface of each asphalt concrete course for smoothness, using 10' 0" (3.04 m) straightedge applied parallel with, and at right angles to centerline of paved area. These tests shall be performed under the observation of the Owner's Representative. Surfaces will not be acceptable if the following 10' (3.04 m) straightedge tolerances for smoothness are exceeded.
 - 1. Wearing Course Surface: 3/16" (0.47 cm)
- E. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner's Representative.
- F. Compaction: The Owner's Representative shall perform in place density tests as part of the construction testing requirements using the Nuclear Method in accordance with ASTM D-2922 Method B direct transmission. Field density tests shall be performed at the rate of one test per 20,000 square feet of pavement.

3.8 MAINTENANCE AND PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 2 days, or until surface temperature is less than 140 degrees F (60 degrees C).

3.9 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch (0.64 centimeters) measured with 10 foot (3.04 meter) straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch (0.64 centimeters).
- C. Variation from True Elevation: Within 1/2 inch (1.27 centimeter).

END OF SECTION 321216

SECTION 330000—OTHER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

Project Specifications:

1. Section 02 01 10 – Maintenance of Existing Conditions
2. Section 02 10 00 – Protection of Existing Utilities
3. Section 31 90 00 – Trench Excavation and Backfill

- B. Project Documents:

1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide other utilities in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
1. Furnish labor, materials, services, equipment, and other necessary items required to excavate, install and backfill the piping, conduit, duct banks and manhole/pull box structures related to the on-site primary and secondary electrical service, telephone/data, and natural gas services in accordance with the Contract Documents.
 2. Refer to site mechanical, plumbing, electrical, and AV drawings for division of construction responsibility between site work contractor and utility companies.
 3. This specification does not include work within the building footprint.

1.1 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Engineer.
- B. The Contractor must provide the following submittals to the Engineer, Architect, and Owner or Owner's Representative for approval prior to purchase of materials:

1. Material Certificates: Submit materials certificate to the Engineer and Owner or Owner's Representative which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.
 2. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.
 3. Product Data: Submit manufacturers cut sheets, component construction, features, configurations and dimensions.
 4. Product Certificates: Submit product certificate which is signed by manufacturer and Contractor, certifying that products comply with, or exceed, the requirements herein, and requirements identified on the construction documents.
- C. Indicate underground structures and show pipe types, sizes, and materials and storm lateral connection(s) to level spreaders. Also, elevations of other utilities crossing system piping.
- D. The contractor shall accurately record actual locations of pipe runs, connections, outlet structures, headwalls, and invert elevations. The Contractor shall provide the owner with an as-built survey, performed by a licensed surveyor within 30 days of project completion.
- 1.2 QUALITY ASSURANCE
- A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places, and the sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged beyond repair during delivery will be rejected and, if already installed, shall be repaired to the Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.
- B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface of all concrete shall be dense, close textured and free of blisters, cracks, roughness and exposure of reinforcement.
- 1.3 CONTRACTOR RESPONSIBILITIES
- A. Contractor is responsible for coordinating this work with other trades on-site.
- B. All work must be coordinated with the electric, gas, telephone/data, and cable utility companies and shall comply with all requirements, details, regulations, etc. of said companies.
- C. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.
- 1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.
- 1.5 PERMITS AND APPROVALS
- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work

authorized by the permit.

- B. Connections with existing facilities shall be performed in accordance with the requirements of the Owner of the facility. The Contractor shall be required to comply with all such requirements, including securing all permits, and payment of all permit and/or connection fees.

1.6 PROJECT RECORD DOCUMENTS

- A. Upon completion of the work of this and related sections, the contractor shall provide the Owner with an as-built survey of all new storm sewer, water, and gas service lines. The data shall include invert elevations at the connection point to the existing infrastructure, tied into established project benchmarks. The survey shall be provided in digital (AutoCAD DWG) and paper formats, and shall be signed and sealed by a New York State Licensed Professional Land Surveyor. This survey may be combined with other as-built survey requirements of site-work items, with the approval of the Owner. Marked-up design plans are not acceptable for the requirements of this section.

1.7 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
 - 1. Local Electric Utility Construction Specifications
 - 2. Local Telephone Utility Construction Specifications
 - 3. Local Natural Gas Utility Construction Specifications
 - 4. New York State Department of Environmental Conservation rules, regulations, and guidelines
 - 5. United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.

1.8 COORDINATION

- 1. All work in this section shall be coordinated with the telephone/data utility companies and shall comply with all requirements, details, regulations, etc. of said companies. The Contractor shall coordinate with each utility to define where his limit of work exists prior to submitting a bid price.
 - a. All utility work extending beyond the limits of the archaeological area of potential effect as defined in the reference archaeological report and contract documents shall be brought to the attention of the Owner.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Bedding and Backfill: Refer to Section 319000.

2.2 CONDUIT, FITTINGS AND CABLE

- A. Telephone/Data, Cable: Refer to Division 16 Technical Specifications and the Contract Drawings.

- B. Natural Gas: All piping, valves and appurtenances shall be supplied by the utility company and the USAG Engineering Planning Standards.

2.3 RELATED MATERIALS

A. Warning Tape

1. Provide plastic-encased aluminum warning tape above utility along entire route.
2. Provide one strip of warning tape per 12-inch (30.5-cm) encasement width, or portion thereof.
3. Warning tape shall read "CAUTION – <UTILITY TYPE> CABLE BELOW"

B. Concrete Pigment

1. Top of encasement shall be dyed to match the corresponding color as dictated by the American Public Works Association Uniform Color Code.
2. Dye shall be applied by mixing powdered pigment into top of concrete encasement.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions.
- B. Verify building service connection points with architectural and MEP and AV plans.

3.2 PREPARATION

A. Conduit

1. Remove scale and dirt, on inside and outside of conduit, prior to assembly.
2. Prepare conduit in accordance with manufacturer's recommendations.

3.3 BEDDING

- A. Excavate all utility trenches and place bedding in accordance with Section 319000 and Contract Drawings.

3.4 INSTALLATION – CONDUIT

- A. Maintain minimum conduit separation in accordance with state and/or local code.
- B. Place forms for concrete encased duct banks. Install conduit to conserve space and to allow for expansion and contraction without stressing conduit or joints. Pour concrete and vibrate to ensure there are no voids. Dye top of encasement in accordance with specification requirements.
- C. Backfill trench in accordance with Section 319000. Install warning tape in accordance with specification requirements.
- D. Install conduit in the line and grade indicated on the Construction Drawings.
- E. Construct service lines to within 5 feet of the exterior building wall at the building entry point

3.5 DAMAGE

- A. Any product, which is damaged or disturbed through any cause prior to acceptance of the Work, shall be repaired, realigned, or replaced as directed by the Owner's Representative, at no expense to the Owner.

3.6 FIELD QUALITY CONTROL

- A. Upon completion of the work of this and related sections, the contractor shall provide the owner with an as-built survey of installed utilities. The survey shall be provided in digital (AutoCAD DWG) and paper formats, and shall be signed and sealed by a New York State Licensed Professional Land Surveyor. This survey may be combined with other as-built survey requirements of site work items, with the approval of the Owner.

END OF SECTION 330000

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SECTION 331000 – WATER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Project Specifications:
 - 1. Section 02 01 10 – Maintenance of Existing Conditions
 - 2. Section 31 90 00 – Trench Excavation and Backfill for Utilities
 - 3. Section 33 40 00 – Storm Drainage Utilities
- C. Project Documents:
 - 1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide Water Utilities in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
 - 1. Furnish labor, materials, services, equipment, and other necessary items required for accompanying the construction of the water systems. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line. Set lines, elevations, and grades for water distribution system work for duration of work including careful maintenance of benchmarks, property corners, monuments, or other reference points.
 - 2. This specification does not include work within the building footprint.

1.1 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Engineer.
- B. The Contractor must provide the following submittals to the Engineer, Architect, and Owner or Owner's Representative for approval prior to purchase of materials:

1. Material Certificates: Submit materials certificate to the Engineer and Owner or Owner's Representative which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.
 2. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.
 3. Product Data: Submit manufacturers cut sheets, component construction, features, configurations and dimensions.
 4. Product Certificates: Submit product certificate which is signed by manufacturer and Contractor, certifying that products comply with, or exceed, the requirements herein, and requirements identified on the construction documents.
 5. Shop Drawings: Submit plans indicating locations, elevations, and piping sizes.
- C. Accurately record actual locations of pipe runs, connections, and invert elevations. The Contractor shall provide the owner with as-built documents within 30 days of project completion.

1.2 QUALITY ASSURANCE

- A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places, and the sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged beyond repair during delivery will be rejected and, if already installed, shall be repaired to the Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.
- B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface of all concrete shall be dense, close textured and free of blisters, cracks, roughness and exposure of reinforcement.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Contractor is responsible for coordinating this work with other trades on-site.
- B. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.

1.5 PERMITS AND APPROVALS

- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work authorized by the permit.
- B. Connections with existing facilities shall be performed in accordance with the requirements of the Owner of the facility. The Contractor shall be required to comply with all such requirements, including securing all permits, and payment of all permit and/or connection fees.

1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of pipe runs, connections, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.
- C. Contractor to submit detailed as-built survey of all installed utilities. As-built survey must be conducted when utility trench is opened and installed utility runs and appurtenances are clearly visible. Accurate location of stubbed and capped utilities must be recorded.

1.7 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
 - 1. American Society for Testing Materials (ASTM), American National Standards Institute (ANSI), and American Water Works Association (AWWA)
 - a. ANSI/ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
 - b. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - c. ASTM B88 - Seamless Copper Water Tube.
 - d. ANSI/AWS A5.8 - Brazing Filler Metal.
 - e. ANSI/AWWA C104 - Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 - f. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
 - g. ANSI/AWWA C111- Rubber-Gasket Joints for Ductile Iron and Grey Iron Pressure Pipe and Fittings.
 - h. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand Lined Molds, for Water or Other Liquids
 - i. ANSI/AWWA C500 - Gate Valves, 3 through 48 inches NPS, for Water and Sewage Systems.
 - j. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.
 - k. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.
 - l. ANSI/AWWA C508 - Swing Check Valves for Waterworks Service, 2 inches through 24 inches NPS.
 - m. ANSI/AWWA C509 - Resilient Seated Gate Valves 3 inches through 12 inches NPS, for Water and Sewage Systems.
 - n. ANSI/AWWA C600 - Installation of Ductile Iron Water Mains and Appurtenances.
 - o. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.
 - 2. New York State Department of Environmental Conservation rules, regulations and guidelines.
 - 3. United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. As required by applicable codes and regulations for water main and building service work.

2.2 GEOTEXTILES AND GEOGRID MATERIALS

- A. As required by applicable codes and regulations for water main and building service work.

2.3 WATER PIPE MATERIALS AND ACCESSORIES

- A. Ductile Iron Pipe: Cement-Lined, ANSI A21.10 (AWWA C-151) Class 56 for pipe 6 inch diameter and larger; Class 52 for smaller than 6 inch diameter:
 - 1. Fittings: Ductile iron, standard thickness.
 - 2. Joints: AWWA C151, mechanical joints.
 - 3. Cement mortar lining: AWWA C-104.
 - 4. Retainer glands: EBBA Series 100 or approved equal.
- B. Gate Valves – 3 inches (75 mm) and over
 - 1. Manually operated, inside non-rising stem, ductile iron body/bonnet/seal plate, non-packing, bronze seated, double disc, seating wedge mechanism gate valve; model and manufacturer as approved by USAG Engineering Planning Standards.

2.4 CONCRETE MATERIALS

- A. Concrete for Thrust Blocks: Place thrust blocking consisting of 3,000 psi concrete to provide sufficient bearing area to transmit unbalanced thrust from bends, tees, caps, or plugs to undisturbed soil without loading undisturbed soil in excess of 2,500 lbs/sq. ft. when water main pressure is 100 psi.

2.5 PRODUCT SUBSTITUTIONS

- A. All products shall be as approved by USAG Engineering Planning Standards. No substitutions will be accepted without prior approval by United States Army Corps of Engineers and other authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions.
- B. Verify building service connection points with architectural plans.
- C. Verify that existing water main size, location, and invert are as indicated on the drawings.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 CLEANING

- A. After the system has been cleaned, the Contractor shall thoroughly inspect the system and all repairs shown to be necessary shall be promptly made by the Contractor.
- B. All Work of cleaning and repair as specified herein shall be performed at the Contractor's expense and to the complete satisfaction of the Owner.
- C. Disinfection of Water Piping System
 - 1. Sterilize distribution system with a solution of not less than 50 parts per million of chlorine with water prior to domestic operation. Thoroughly flush lines before introduction of chlorinating materials and after the contact period of at least 24 hours. De-chlorinate water prior to flushing into storm sewer system.
 - 2. Open and close valves in lines being sterilized several times during contact period. System shall be flushed with clean water until residual chlorine content is less than 1.0 part per million.
 - 3. After sterilization, test water for bacterium in accordance with AWWA specifications. Do not place distribution system in service until approval is obtained from applicable governing authorities.

3.4 BEDDING

- A. Excavate pipe trench in accordance with Section 319000.
- B. Form and place concrete for pipe thrust restraints at any change of pipe direction.
- C. Place bedding material at trench bottom.
- D. Backfill around sides and to top of pipe with cover fill, tamp in place and compact in accordance with Section 319000.

3.5 INSTALLATION – PIPE

- A. Maintain separation of water main from sanitary and storm sewer piping in accordance with state and local code. Unless otherwise approved, water mains shall be separated from sanitary sewer pipes a minimum distance of 10 feet horizontal and 18 inches vertical.
- B. Install ductile iron piping and fittings to ANSI/AWWA C600.
- C. Route pipe in straight line.
- D. Install pipe to allow for expansion and contraction without stressing pipe or joints.

- E. Install access fittings to permit disinfection of water system performed under this section.
- F. Slope water pipe and position drains at low points.
- G. Form and place concrete for thrust restraints at each elbow or change of direction of pipe main.
- H. Coordinate with the West Point Department of Public Works for new wet tap to existing main.
- I. Establish elevations of buried piping to ensure not less than 4 feet (1.25 m) of cover over the top of pipe under proposed grading. Locations where shallow cover cannot be avoided must be brought to the attention of the Owner for review.
- J. Backfill trench in accordance with Section 319000.
- K. Connections with Existing Pipelines: Where connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each on-site wet tap connection under conditions which least interfere with operation of existing pipeline.

3.6 FIELD QUALITY CONTROL

- A. Water line installation and testing shall be certified by a licensed plumber. The Contractor shall cooperate with the Owner's Representative as required to facilitate testing and inspection of the work.
- B. Test water distribution system installed below grade and outside the building in accordance with the following procedures:
 - 1. All pipework shall be tested at a hydrostatic pressure equal to 150 psi (1,034 kPa). The pipe work shall maintain said pressure for not less than two hours.
 - 2. Furnish, install, and operate the necessary connections. Leakage shall not exceed that permitted by AWWA Specifications C600-64 for mechanical joint and push-on joint pipe.
 - 3. Locate and repair any leaks. Repeat testing until process results are satisfactory and in compliance with this section.
 - 4. Furnish a copy of the results of the hydrostatic pressure test to the Owner upon completion of water distribution system backfilling operations
- C. Contractor shall call for West Point Department of Public Works or other authority having jurisdiction for inspection of all waterline work and shall be responsible for obtaining all signoffs, including but not limited to tap release letters and meter release letters.
- D. All waterline work shall be constructed in accordance with the latest version USAG Engineering Planning Standards and other referenced and applicable codes and regulations.

3.7 INSPECTION AND TESTING

- A. Final Inspection: Upon completion of the Work and before backfill is placed and final acceptance by the Owner, the entire drainage system shall be subject to a final inspection in the presence of the Engineer or Owner's Representative. The Work shall not be considered as complete until all requirements for line, grade, cleanliness, and workmanship have been completed to the satisfaction of the Owner's Representative and/or the Engineer.

END OF SECTION 331000

SECTION 33-40-00 – STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Specifications (including all Division 01 Specification Sections), and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Project Specifications:
 - 1. Section 02 01 10 – Maintenance of Existing Conditions
 - 2. Section 31 90 00 – Trench Excavation and Backfill for Utilities
 - 3. Section 31 25 00 – Erosion and Sedimentation Controls
- C. Project Documents:
 - 1. Contract Documents and Contract Drawings

1.2 SUMMARY

- A. Work of this section, as shown or specified, shall provide Storm Drainage Utilities in accordance with the requirements of the Contract Documents. The Contractor must accept the site as-is and shall be deemed to have inspected the site and reviewed all Contract Documents prior to submitting a bid.

1.3 WORK INCLUDED

- A. Overall work under this Contract shall include all labor, materials, equipment, supervision, coordination efforts, permitting costs, certificate costs, services, filing fees, testing costs, security, insurance and all other associated or related items specified herein that are necessary and are required to complete the Work. Work elements shall include:
 - 1. Storm drainage piping, excavation, fittings and accessories, and bedding.
 - 2. Storm structures, cleanouts, catch basins etc.

1.4 SUBMITTALS

- A. No work shall be performed until shop drawings, if required, have been reviewed and accepted by the Engineer.
- B. The Contractor must provide the following submittals to the Engineer, Architect, and Owner or Owner's Representative for approval prior to purchase of materials:
 - 1. Material Certificates: Submit materials certificate to the Engineer and Owner or Owner's Representative which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein and applicable regulatory requirements.
 - 2. Product Warranty: Submit documentation of standard product warranty terms for all products pertaining to this section.
 - 3. Product Data: Submit manufacturers cut sheets, component construction, features, configurations and dimensions.

- 4. Product Certificates: Submit product certificate which is signed by manufacturer and Contractor, certifying that products comply with, or exceed, the requirements herein, and requirements identified on the construction documents.
 - 5. Shop Drawings: Submit plans indicating locations, elevations, invert elevations, piping, sizes and elevation penetrations of the on-site storm system, and storm detention system.
 - C. Indicate underground structures and show pipe types, sizes, and materials and storm connection(s). Also, elevations of other utilities crossing system piping.
 - D. The contractor shall accurately record actual locations of pipe runs, connections, outlet structures, headwalls, and invert elevations. The Contractor shall provide the owner with an as-built survey, performed by a licensed surveyor within 30 days of project completion.
- 1.5 QUALITY ASSURANCE
- A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, or on the work site after delivery, or at both places, and the sections shall be subject to rejection at any time if material conditions fail to meet any of the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. All sections which have been damaged beyond repair during delivery will be rejected and, if already installed, shall be repaired to the Engineer's acceptance level, if permitted, or removed and replaced, entirely at the Contractor's expense.
 - B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface of all concrete shall be dense, close textured and free of blisters, cracks, roughness and exposure of reinforcement.
 - C. Concrete imperfections may be repaired, subject to the acceptance of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final acceptance. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days when tested in 3 inch diameter by 6 inch long cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs.
- 1.6 CONTRACTOR RESPONSIBILITIES
- A. Contractor is responsible for coordinating this work with other trades on-site.
 - B. Identify and describe to the Engineer and design team unexpected variations to subsoil conditions and the discovery of uncharted utilities.
- 1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, and handle materials as recommended by the manufacturer to protect from damage.
- 1.8 PERMITS AND APPROVALS
- A. Contractor shall prepare and obtain all required permits prior to construction unless otherwise directed by Owner. Copies of all permits shall be supplied to the Owner prior to the commencement of work

authorized by the permit.

1.9 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of pipe runs, connections, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions and the discovery of uncharted utilities.
- C. Contractor to submit detailed as-built survey of all installed utilities. As-built survey must be conducted when utility trench is opened and installed utility runs and appurtenances are clearly visible. Accurate location of stubbed and capped utilities must be recorded.

1.10 REFERENCE STANDARDS

- A. Unless more restrictive criteria or differing requirements are explicitly stated in the Specifications, or mandated by governing codes or regulations, the recommendations, suggestions, and requirements described in the referenced standards shall be deemed mandatory and applicable to the Work.
- B. The latest edition, as of the date of the executed construction contract, of referenced standards listed below applies to this contract.
 - 1. American Society for Testing Materials (ASTM), American National Standards Institute (ANSI), American Water Works Association (AWWA), and American Association of State Highway and Transportation Officials (AASHTO)
 - a. ASTM A48 – Gray Iron Casting.
 - b. ASTM C478 – Precast Reinforced Concrete Manhole Sections.
 - c. ASTM C923 – Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes.
 - d. ASTM D1248 – Polyethylene Plastics Molding and Extrusion Materials.
 - e. ASTM D3350 – Polyethylene Plastics Pipe and Fittings Materials
 - f. ANSI/ASTM C14 – Concrete Sewer, Storm Drain and Culvert Pipe.
 - g. ANSI/ASTM C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - h. ANSI/ASTM C443 – Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - i. ANSI/ASTM C507 – Reinforce Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
 - j. ANSI/ASTM D3034 – Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
 - k. ANSI C150/AWWA A21.50 – Ductile Iron Pipe (DIP) Class 56, Cement-Lined Tyton Joints.
 - l. ANSI C151/AWWA A21.51 – Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
 - m. AWWA C153 – Fitting Casting Contract Documents and Contract Drawings
 - n. AWWA C153 – Compact Ductile-Iron Fittings.
 - o. AASHTO M294 and M252 – Corrugated Polyethylene Pipe Smooth Interior.
 - 2. New York State Department of Environmental Conservation rules, regulations and guidelines.
 - 3. United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.

PART 2 - PRODUCTS

2.1 SEWER PIPE MATERIALS AND ACCESSORIES

- A. Ductile Iron Pipe: Comply with the requirements of AWWA C115-Flanged Ductile Iron Pipe with threaded flange.
- B. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: ASTM A 74 Service class, gray iron, for gasketed joints. Include ASTM C 564 rubber, compression-type gaskets.
- C. Corrugated Polyethylene Pipe: (N-12) pipe shall have a full circular cross-section, with an outer corrugated perforated pipe wall and an essentially smooth inner wall (waterway). Corrugations for these sizes may be either annular or spiral. Size shall conform to the AASHTO classification "Type SP" (which describes pipe with a smooth waterway and Class 2 perforations). Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions, and markings found in AASHTO Designations M252 and M294. Pipe and fittings shall be made from virgin polyethylene compounds which conform to the requirements of cell Class 324420C, as defined and described in ASTM D3350.

Acceptable manufacturers include (Or approved equal):

- 1. Advanced Drainage Systems, Inc. (ADS) Staybrook Industrial Area, Ludlow, MA.
- D. Corrugated PE Drainage Tubing and Fittings: AASHTO M 252, Type S, with smooth waterway for coupling joints.
 - 1. Soiltight Couplings: AASHTO M 252, corrugated, matching tube and fittings to form soiltight joints.
- E. Corrugated PE Pipe and Fittings: AASHTO M 294, Type S, with smooth waterway for coupling joints.
 - 1. Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings to form soiltight joints.
- F. HDPE: High-Density Polyethylene Pipe shall comply with requirements of AASHTO M252 Type S for 4" through 10" diameter pipe and AASHTO M294, Type S for 12" through 60" diameter. Fittings shall be watertight and conform to AASHTO M294, AASHTO M252, and ASTM D3350 Cell Classification 435400C. Joints shall be bell and spigot with an o-ring gasket meeting ASTM F477.

Acceptable manufacturers include (Or approved equal):

- 1. Advanced Drainage Systems, Inc. N-12 pipe (MEA 301-96-M) for sizes up to 60" diameter;
- 2. Hancor Inc. Sure-Lok pipe (MEA 321-99-M)
- G. Bedding: Section 319000 – Trench Excavation and Backfill for Utilities.

2.2 UTILITY STRUCTURES

- A. Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading, with provision for sealant joints.
 - 1. Joint Sealants: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.

2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
3. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 48 inches (1220 mm).
4. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
5. Include 24-by-24-inch- (610-by-610-mm-) minimum flat grate with small square or short-slotted drainage openings. ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading.

2.3 CLEAN OUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with heavy-duty top-loading classification in vehicle-traffic service areas and medium-duty in paved foot-traffic areas.
- B. Lid and Frame: Heavy Duty cast iron construction manufactured by Campbell Foundry or approved equal. Closed Locking Lid Design.
- C. Shaft Construction: Cast Iron shaft of internal diameter as specified on plans with 4,000 psi concrete collar for cleanouts located in paved areas.
- D. Base Pad: Cast-in-place concrete, 4,000 psi leveled top surface to receive cast iron shaft sections, sleeved to receive sanitary sewer pipe sections.
- E. Project substitutions shall be submitted to the engineer for review and approval in accordance with the requirements of section 1.6 – Submittals

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify the trench cut and excavation base to be hard, smooth, and dry.
- B. Verify excavation location, dimensions and elevation with contract drawings.
- C. Ensure all OSHA requirements are met prior to beginning work, including trenching and excavation requirements. Do not begin work if the site is unsafe or if OSHA requirements are not met.

3.2 PREPARATION

- A. Hand trim excavations to required elevations and thoroughly compact as per Section 31-90-00.
- B. Remove large stones or other hard matter which may damage piping or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 31-90-00 for work of this section.
- B. Place and compact a minimum 6-inch bedding material at trench bottom. Hand trim bedding for accurate placement of pipe to elevations indicated.
- C. Maintain moisture content of bedding material between 1% below and 3% above the optimum.
- D. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream.
- E. Install piping pitched at minimum slope of 1 percent and 36-inch (1000-mm) minimum cover unless otherwise indicated.
- F. Install pipe, fittings, and accessories in accordance with the Reference Standards listed above in section 1.11, the manufacturer's instructions and/or state or local requirements. Seal joints to be watertight.
- G. Lay pipe to slope gradients noted on Contract Documents; with maximum variation from true slope of 1/32 inch in 20 feet.
- H. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- I. Install hub-and-spigot, cast-iron soil pipe and fittings with rubber gaskets according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Volume I. Use gaskets that match class of pipe and fittings.
- J. Install PE pipe and fittings according to ASTM D 2321. Join pipe, tubing, and fittings with couplings for soiltight joints according to manufacturer's written instructions. Install corrugated piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."
- K. Install PVC pipe and gasketed fittings with gaskets according to ASTM D 2321.
- L. Install corrugated steel piping according to ASTM A 798/A 798M.
- M. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- N. Refer to Section 31-90-00 for trenching and backfill requirements. Do not displace or damage pipe when compacting.

3.4 INSTALLATION – CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for storm pipe end sections.
- C. Mount lid and frame level in grout to finished grade elevation indicated on plan.

3.5 INTERFACE WITH EXISTING FACILITIES

- A. Compliance with Facility Owner Requirements: Connections made into existing facilities shall be performed in accordance with the requirements of the United States Army Garrison Engineering Planning Standards, and relevant codes and regulations cited therein.

3.6 MODIFICATIONS OF EXISTING STRUCTURES

- A. General: The Contractor shall alter, reconstruct and/or convert existing structures where and as shown on the Drawings, and/or as approved by the Commissioner. In general, alterations shall be performed with the same type of material used in the original construction unless otherwise indicated on the Drawings or approved by the Commissioner.

- 3.7 Damage to Existing Installations: The Contractor shall exercise extreme care during such alteration, reconstruction and/or conversions so as not to damage any portions of the structure and/or pipe shown to remain. Any such damage shall be repaired by the Contractor at his own expense and to the satisfaction of the Commissioner.

3.8 CLEANING

- A. The Contractor shall clean the entire drainage system of all debris and obstructions. This shall include, but not be limited to, removal of all formwork from structures, concrete and mortar droppings, construction debris and dirt. The system shall be thoroughly flushed clean and the Contractor shall furnish all necessary hose, pumps, pipe and other equipment that may be required for this purpose. No debris shall be flushed into existing storm drains or streams; all debris shall be removed from the system.
- B. After the system has been cleaned, the Contractor shall thoroughly inspect the system and all repairs shown to be necessary shall be promptly made by the Contractor.
- C. All Work of cleaning and repair as specified herein shall be performed at the Contractor's expense and to the complete satisfaction of the Owner.

3.9 INSPECTION AND TESTING

- A. Final Inspection: Upon completion of the Work and before backfill is placed and final acceptance by the Owner, the entire drainage system shall be subject to a final inspection in the presence of the Engineer or Owner's Representative. The Work shall not be considered as complete until all requirements for line, grade, cleanliness, and workmanship have been completed to the satisfaction of the Owner's Representative and/or the Engineer.
- B. If work does not meet specified requirements, the contractor is to remove work, replace and retest at no additional cost to the owner.

END OF SECTION 334000

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